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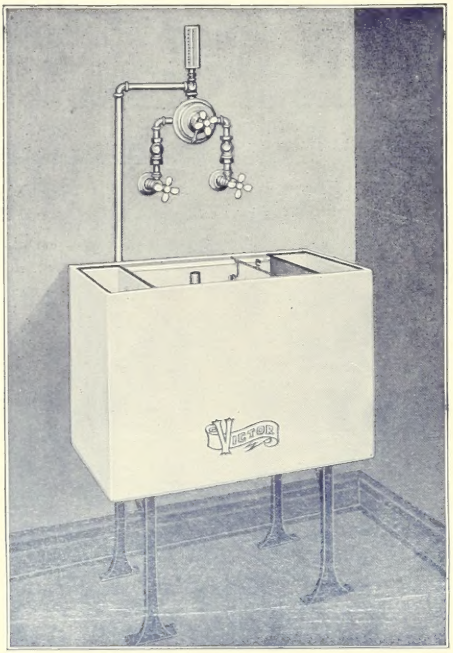

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CONTENTS

Errors in the Roentgenologic Diagnosis of Duodenal Ulcer 163
(Russell D. Carman, M. D.)

Practical Applications of Ionization Measurements of X-rays 169
(Arthur W. Erskine, M. D.)

Treatment of Malignant Neoplasms of the Tonsils 173
(Douglas Quick, M. B. [Tor.])

Fractures of the Carpal Scaphoid 179
(Albert M. Pfeffer, M. D.)

Editorials 182

- Scientific Research—or the Social Whirlwind.
  - Introduction.
  - A Scientific Obligation.
  - The Radiologists' Problems.
  - Research Now in Progress.
  - Scientific Agencies Listed.
  - Proffered Assistance.
  - Some Pertinent Suggestions.
  - Future Possibilities.
  - The Place of Beginning.
- Program Summer Meeting.
- Program American Radium Society.
- Military Roentgenology.
- Dr. William Duane.
- Dr. Preston M. Hickey.
- Detroit Radiological Society.
- Persuasive Diagnosis.
- Proposed Questionairre to Nursing Profession.

New Equipment 197

Abstracts and Reviews 201

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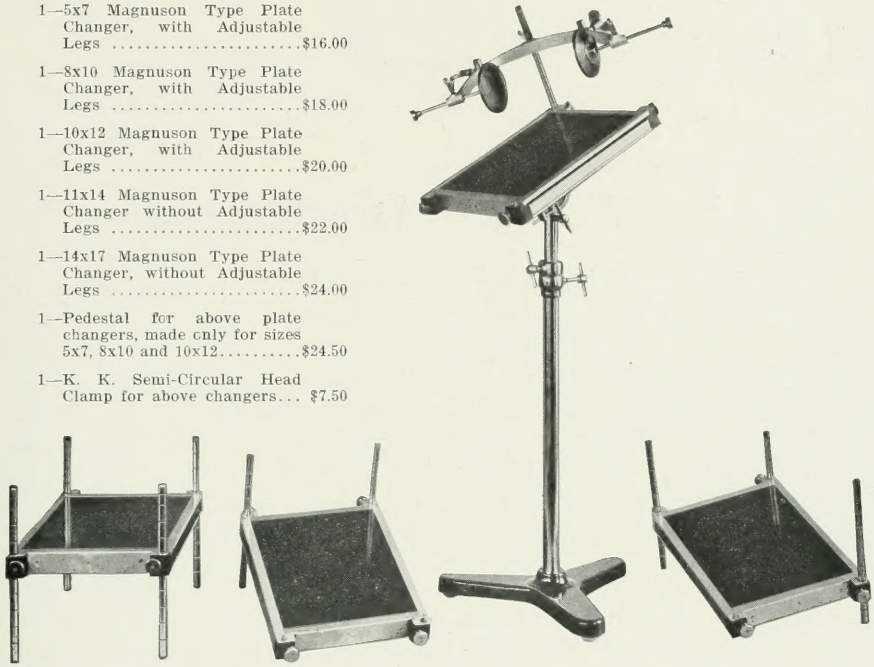

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Errors in the Roentgenologic Diagnosis of Duodenal Ulcer*

RUSSELL D. CARMAN, M. D.
Section of Roentgenology, Mayo Clinic
Rochester, Minn.

LESS than a decade ago, at a time the roentgenology of gastric cancer and ulcer had already gained definite recognition, investigation of the duodenum was considered impracticable. Today the diagnosis of duodenal ulcer is so thoroughly developed that the roentgenologist can discover the lesion with facility and with only a small percentage of error.

To discuss these errors may give a wrong impression, namely, that the diagnosis is attended with difficulty or that the roentgenologic findings are unreliable. Yet it is only by reviewing mistakes that we can learn whether it is possible to avoid them.

Laying aside the various minor and indirect signs of duodenal ulcer, there are but two trustworthy indications of this lesion. They are deformity of the duodenal contour, and the combination of retention and hyperperistalsis in a large but otherwise normal stomach. Hence, any mistakes should hinge chiefly on the elicitation or interpretation of these phenomena. The errors made are also of two classes—those of affirmation, when an ulcer is diagnosed but not found at operation, and those of negation, when an ulcer is not diagnosed, but is found at operation.

Among the causes of affirmative error are the following:

1. Technical errors and difficulties. Failure to fill the bulb completely. Retraction of the abdominal wall. Blending of the bulbar shadow with that of other portions of the duodenum or of adjacent concretions. Diagnosis on incomplete examinations.

2. Deformity of the bulb by causes other than ulcer. Reflex spasm or other inflammatory processes in the right upper quadrant. Extrinsic tumors. Pressure against the spine. Lesions of the duodenum other than ulcer: benign tumors, duodenitis, diverticulum and cancer.

3. Pyloric and prepyloric gastric lesions.

4. Overemphasis of minor auxiliary signs or bias by the clinical history.

Causes of negative error comprise:

1. Technical faults in the examination; insufficient milliamperage; improper voltage; unsuitable tube; too great distance of patient from tube; neglect of the examiner to prepare his eyes; failure to use the diaphragm; failure to examine both roentgenoscopically and roentgenographically.

2. Neglect to examine the duodenum in cases of cardiospasm, or ulcer or other lesion of the stomach.

3. Unfavorable position of the duodenal bulb.

4. Actual or apparent absence of bulbar deformity. Minute ulcers. Absence of spasm from the ulcer. Small but apparently regular bulb due to obstruction of the distal portion of the bulb. Nonobstructive ulcer beyond the bulb.

Affirmative Errors

Adequate filling of the duodenum is absolutely necessary for the demonstration of its actual contour. When the examination is made immediately or shortly after the opaque meal has been given, a method which is in common use, an incompletely filled duodenum may be mistaken for one deformed by ulcer. Of the factors promoting complete filling, free opening of the pylorus is perhaps most important. Free opening is retarded by coarse particles of food. Hence, for the examination fluid mixtures are best. After trying various mediums I have found an aqueous mixture to be the most satisfactory.

Sometimes the bulb is difficult to fill because it is unusually capacious, and persistent efforts may be required. Occasionally a patient, especially one who is apprehensive, retracts his abdominal wall so strongly that the initial out-flow through the pylorus is scant, and the stomach cannot be satisfactorily manipulated to assist duodenal filling.

Manual pressure on the stomach, which I employ routinely, inclining the patient to the right, examination in the right recumbent position, and blocking the lower duodenum with the hand or Holzknecht's distinctor are all well known measures for assisting complete filling. David has employed the duodenal tube for this purpose. Notwithstanding all aids, satisfactory filling cannot always be secured.

Aekerlund describes an occasional looping downward of the duodenum alongside the bulb and the combination as seen in certain projections may simulate bulbar deformity. He also mentions the shadows of gallstones or kidney stones merging with the shadow of the duodenum as a possible source of error. During roentgenoscopy it should be possible by palpation to separate and distinguish the bulb.

Caution against the diagnosis of ulcer after an examination that is lacking in thoroughness should be unnecessary. A positive diagnosis on bulbar distortion is warranted only by deformity which is constant, unvarying as to location, and virtually identical in appearance during the examination. If the examination is roentgenographic only, an ample number of plates should be made.

Spasm of the duodenum resulting from disease of other organs may produce deformity similar to that caused by ulcer. Notable among such diseases are cholecystitis and chronic appendicitis. (Fig. 1). Disease of the pancreas is a possible excitant of duodenal spasm. In one of our cases of cancer of the pancreas a persistent spasm of the bulb was interpreted as ulcer. Not infrequently spasm is associated with concurrent cholecystitis and pancreatitis. Renal calculi have also been suspected as a cause. Disease of the gallbladder or appendix is common in patients sent for roentgen examination of the digestive tract, and the symptoms often resemble those of duodenal ulcer. Fortunately duodenal spasm occurs only in a small proportion of these cases. Like gastric spasm from extrinsic causes it tends to change form and situation. In

*—Presented before The Radiological Society of North America, Chicago, December 7, 1921.

some cases that I have seen the spastic deformity was persistent and unchanging, and caused a mistaken diagnosis of ulcer.

Pericholecystitis and other inflammatory processes in the vicinity of the bulb may distort its contour by adhesions. (Fig. 2). Sometimes this deformity is constant, cannot be distinguished from that of ulcer, and is responsible for a considerable proportion of errors. Aekerlund is of the opinion that the deformity they produce is often characterized by fine shallow irregularities, sometimes variable, and different from the typical defects caused by ulcer. I have not as yet observed any dependable differential features of adhesions. It is to be remembered also that adhesions may result from a perforated ulcer. Deformity of the bulb is not an inevitable sequence of adhesions, as I have seen many patients in whom at operation the first part of the duodenum was found to be embedded in adhesions although the bulbar contour was quite normal in appearance. Very rarely, sixty-hour gastric retention and hyperperistalsis may result from obstructive pericholecystic adhesions.

Extrinsic tumors infringing on the bulbar contour are not common. They should usually be palpable and their presence thus be evident. The gall-bladder sometimes makes a smoothly curved indentation in the bulb, but this is patently different from the irregular deformity caused by ulcer. Pressure against the spine may cause a bulbar filling defect. This can be eliminated by palpatory shifting during roentgenoscopy.

Benign tumors within the bulb are pathologic novelties. I have had one case in which the bulb contained a hemangioma. It appeared as a central filling defect in a large bulb of unbroken outline and the diagnosis of an intraduodenal tumor was obvious. Aekerlund has seen a few cases of papilloma with similar signs and only one was diagnosed as ulcer. I have observed one case, diagnosed by the aid of the roentgen ray as ulcer, in which the surgeon found a diverticulum on an angiomatous base but could not determine whether an ulcer existed or not. In another instance a diverticulum was found opposite an ulcer which had been diagnosed, but diverticula occur more commonly around the ampulla of Vater.

Judd has recently called attention to an eccentric form of ulcer which he calls the duodenitis type, or submucous ulcer. When excised the mucosal surface seems normal, but on close examination one or more pin-point ulcers are found, and the submucosa and muscularis are infiltrated. Spastic bulbar deformity is usually present in these cases just as in other types of ulcer. (Fig. 3). Designating this type of ulcer has no bearing on clinical diagnosis or treatment, but in the absence of induration and marked mucosal erosion a cautious surgeon might doubt the validity of the roentgen diagnosis. This consideration also applies to the occasional small ulcer which, after the abdomen is opened, shows no manifestations on the serosal surface, is not palpable, and is found only by incising the duodenum.

Cancer of the duodenum is among the rarities. Only five cases have been observed at the clinic in its entire history. None of four cases examined by the roentgen ray was mistaken for ulcer, and the growth was distal to the bulb in every instance.

Gastric lesions near the pylorus may be deceptive in various ways. Occasionally prepyloric cancer or ulcer does not visibly deform the antrum, and at the same time, if obstructive, gives rise to gastric retention and hyperperistalsis, or the lesion may produce deformity resembling a distorted bulb, and the examiner may be unable to determine the exact site of the pyloric ring. (Fig. 4).

Error from stressing the subordinate signs of ulcer or being unduly influenced by the clinical history is scarcely excusable. Gastric hypertonus, hyperperistalsis (without retention), and hypermotility are not of themselves indicative of duodenal ulcer.

Negative Errors

Satisfactory roentgenoscopic examination requires attention to many technical details. If these are disregarded an ulcer may easily escape recognition on the screen. Two features are essential; the image must be clear and the examiner's vision must be adapted to the relative darkness. To secure a clear image the milliamperage and voltage should be appropriate, the tube should have a focus as sharp as is consistent with reasonable endurance, the screen should be of the best quality, the patient should be close to the tube and the diaphragm should be actively employed to narrow the field of observation.

In a case of cardiospasm the establishment of its diagnosis by the roentgen ray would seem to be sufficient, but I have been impressed by a few cases in which the condition was accompanied by duodenal ulcer. The relationship of duodenal ulcer to gastric spasm is well known and it is not unreasonable to suspect a similar connection with cardiospasm. At the clinic we now request that after dilation for cardiospasm the patient be returned for examination of the duodenum.

Occasional association of duodenal ulcer with gastric ulcer is a familiar fact. When the latter is found a careful search for a possible companion in the duodenum should ordinarily not be omitted. However, when the gastric

Figure I.—(Case A-342931)—Spastic deformity of the bulb, diagnosed as duodenal ulcer in a case of chronic appendicitis.

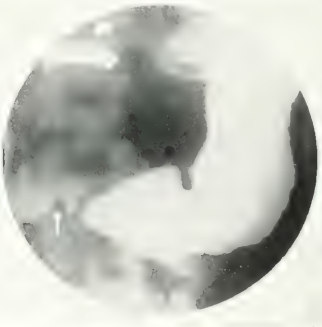

Figure II.—(Case A-363070)—Deformity of the duodenal bulb, associated with cholecystitis and adhesions. This deformity was diagnosed as duodenal ulcer.

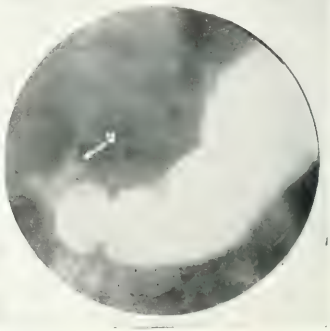

Figure III.—(Case A-59961)—Duodenitis with spastic bulbar deformity.

ulcer is obviously of such character that perforation might result from manipulation, or when the patient is so weak that the examination is harassing, the examiner should be satisfied with the demonstration of the gastric ulcer alone. (Fig. 5).

A duodenum which turns backward from the pylorus and is overlapped by the antral shadow in the anterior view is much more difficult to examine than the erect cap. In such instances the stomach is usually of the steer-horn type, is swung more or less horizontally, and the pylorus lies well to the right. By turning the patient into the right oblique view, carrying it almost to the right lateral position if necessary, the cap can usually be seen.

It is a standard and safe rule that a duodenal bulb of normal outline negates the presence of ulcer. This is not absolutely true, for I have seen a few patients in whom the duodenal contour was apparently undeformed, but which at operation were found to have ulcer. Absence of spasm or minuteness of the ulcer may explain the lack of deformity. I have noted exceptional instances in which even an extensive perforated ulcer failed to distort the bulb as seen by the roentgen ray. On the other hand, a small ulcer with active spasm may be readily detected. The surgeon is sometimes puzzled by these apparent inconsistencies of roentgen diagnosis.

A small minority of ulcers are located beyond the bulb in the second or third portions of the duodenum. In such instances the contour is not altered and if the distal duodenum is deformed it cannot be distinguished ordinarily by the roentgen ray from the irregular outline produced by the valvulae conniventes. Unless stenosis results with its characteristic signs the roentgen ray will seldom discover the lesion.

Series of Cases

To throw some light on the relative importance of each of these many sources of error I have canvassed our records for the twelve months ending June 30, 1921. During this period five hundred and twenty-two cases in which a diagnosis of duodenal ulcer had been made by the roentgen ray, went to operation. In four hundred and ninety-nine cases the ulcer was found by the surgeon; in twenty-three cases no ulcer could be demonstrated.

Of the twenty-three cases, eight were found to have disease of the gallbladder or appendix, or both. In none of these was the duodenum organically involved, and it may be argued that the bulbar deformity on which the roentgenologic diagnosis of ulcer was based was the result of spasm from the extrinsic lesions.

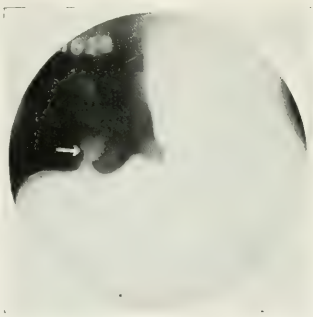

Figure IV.—(Case A-321623)—Carcinoma of the pyloric end of the stomach and of the duodenum. Roentgen diagnosis: duodenal ulcer.

Adhesions around the duodenum were responsible for the wrong diagnosis in seven cases.

Five errors were due to prepyloric lesions, cancer in three cases, ulcer in two. All of these lesions were near the pylorus. A cancer involving the liver, but whose origin was not determined, may have been the cause of the duodenal deformity in one case, and in another the lesion was a cancer of the hepatic flexure.

Thus, in twenty-two of the twenty-three cases there was definite justification for surgical intervention, and in two-thirds of them the lesion was in the right upper quadrant of the abdomen. In the remaining instance nothing could be found to explain the symptoms or diagnosis.

During the same period, of five hundred and forty-four cases in which a negative roentgen ray diagnosis was made, five hundred and twelve were confirmed by operation, and pathologic conditions other than ulcer were found. In the other thirty-two cases, or five and nine-tenths per cent, a duodenal ulcer was discovered at operation, although its presence was not shown by the roentgen ray. Some of these negative errors had no reasonable excuse other than the inevitable fallibility of the examiner. In twelve of the cases the organic changes as described by the surgeon seemed adequate to produce deformity recognizable by the roentgen ray. The changes included various combinations of induration, scarring and contraction, and in three cases perforation had occurred. As I have stated, rather marked organic alterations of the duodenal wall, even perforation, may exist without roentgenologic deformity, and possibly this was the case in some of the thirteen.

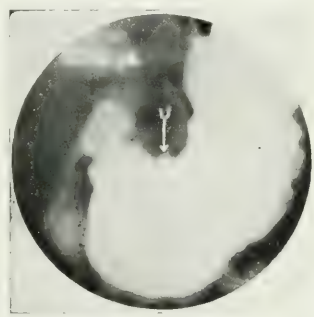

Figure V.—(Case A-337234)—Concurrent gastric and duodenal ulcer. The gastric ulcer, the niche of which is seen at U, was diagnosed. The bulbar contour is normal.

In eleven cases error was probably unavoidable. Eight of the ulcers were described as being small, one-half centimeter or less in diameter, and in the absence of spastic distortion would hardly have been visible. In one case the ulcer was in the second portion of the duodenum, six or eight cm. from the pylorus.

In the remaining nine cases duodenal ulcer coexisted with gastric ulcer. In eight of these the examiner discovered the gastric ulcer but either failed to observe any evidence of the duodenal ulcer, or did not look for it. Roentgenograms preserved in two of the eight cases show a normal bulbar contour. In the ninth case neither the gastric nor the duodenal ulcer was found by the roentgen ray. The gastric ulcer was small and on the posterior wall, but the duodenal ulcer was of the puckered type and should have been discovered.

Summary

The principal causes of affirmative error in the diagnosis of duodenal ulcer in the order of their importance are reflex spasm, periduodenal adhesions and gastric lesions near the pylorus.

Duodenal spasm from extrinsic causes is most often associated with cholecystitis or chronic appendicitis.

Juxtapyloric gastric lesions may implicate the duodenal bulb or alter land marks so that exact diagnosis may be difficult.

Tumors of the duodenum, either benign or malignant, and diverticula are rare sources of error.

Confusion of the bulbar shadow with that of other parts of the duodenum or with the shadows of adjacent concretions is a technical fault which can usually be avoided.

The percentage of negative errors in this series slightly exceeds the percentage of affirmative mistakes. Many of these diagnostic failures are explainable by the absence of bulbar deformity, either organic or spastic.

Failure to diagnose a duodenal ulcer associated with a demonstrable gastric ulcer is not a grave oversight.

Ulcers situated beyond the bulb can hardly be diagnosed as such, although

obstruction may be demonstrable. They constitute a very small percentage of the total.

Many negative errors are avoidable. Some of them are due to technical faults, others are solely the result of careless observation and are indefensible. Perfection is admittedly unattainable, but the roentgenologist should not criticize himself too charitably.

In all that has been said there has been no intention to furnish an alibi for roentgenologic mistakes. On the contrary, although the mistakes of the roentgen ray in the diagnosis of duodenal ulcer are relatively few it is to be hoped that they can be further reduced. Assuming that examination is thorough and careful, the affirmative mistakes seem difficult to attack. Negative errors can doubtless be further lessened by technical precision and closer observation, so that fewer cases with actual bulbar deformity will pass unnoted.

When one considers that the affirmative errors in this series amounted to only four and four-tenths per cent, and how difficult or impossible it is to diagnose the presence of adhesions or spasm due to extrinsic lesions, the wisest procedure for the roentgenologist is to diagnose duodenal ulcer when a definite, persistent deformity of the bulb is seen. The visualization of a well filled bulb, regular in outline, can mean nothing but a normal duodenum from a roentgenologic standpoint.

Finally, the question arises of supplementing the roentgenologic findings with the clinical data in order to make a correlated diagnosis and avoid occasional mistakes. However helpful the clinical facts may have been in the developmental stage of gastric roentgenology and however necessary they still may be for the interpretation of other roentgenologic findings, I believe that their employment at this time by the roentgenologist in the diagnosis of duodenal ulcer is unnecessary and would increase rather than diminish his mistakes. While the typical anamnesis of ulcer is admirably simple and clear, it is not pathognomonic, nor is ulcer always accompanied by a characteristic history.

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Discussion

Dr. Frank Smithies *(Chicago)*: It is not necessary for me to congratulate Dr. Carman upon this very splendid presentation of a difficult subject. I think the fact that he has made a special study of this type of failure in diagnosis indicates how important the subject has become in his own clinic and consequently how important it must be to us of lesser experience. Especially is this to be emphasized when we remember that Dr. Carman is dealing with a material which shows the maximum amount of duodenal deformity, namely a material which has been ill from ulcer or some abdominal complaint for an average time greater than eight years; a material which has passed through many hands, very likely, in an attempt to cure by nonsurgical procedure some definite anomaly. It stands to reason, then, with the maximum amount of scar tissue, the maximum amount of obstruction such as this surgical material has, that the possibility of failure in that type of case, even, must be constantly born in mind. It also indicates that in those cases averaging eight years before reaching the surgical stage of ulcer, there have been greater possibilities for failure in diagnosis and that is particularly the group in which we are interested, not the group which is so ill and so abnormal that surgical procedures are advised by surgeons of eminence and discretion.

I am particularly interested in that group that comes before Dr. Carman's group, that group in which we may expect to have a great many more failures in diagnosis than Dr. Carman has indicated. That these failures occur is common experience to all of us.

What is the percentage of failure in diagnosis before large amounts of scar tissue have developed, before perforations have occurred, before adhesions have occurred? My experience—I am not a roentgenologist—is that the difficulties in the diagnosis of duodenal ulcer previous to the scar tissue stage are higher than Dr. Carman has indicated tonight. This should be emphasized, certainly before a special body such as this is. It would seem to me that the reasons for these failures are many. Certain of them cannot be avoided. There is not sufficient disease yet to produce the permanent deformity in one particular spot which Dr. Carman has emphasized. Furthermore, not sufficient attention is paid to the fluoroscopic examination in a properly prepared patient. All of us are quite familiar with the lack of preparation for roentgenologic examination of the average every day patient—the failure to clean the lower alimentary tract.

White of Boston has clearly shown how a filled rectum, a filled large bowel, a filled terminal ileum has a particular and constant effect on the emptying of the stomach, and on duodenal and gastric peristalsis. It has been emphasized as to the subacute appendix or subacute cholecystitis, the rate of peristalsis or the spasmodic condition of the duodenum itself.

In 1918 I made a special study of the roentgenological side and of the clinical side and the surgical side associated with cholecystitis. We found that thirty-three and a third per cent of the instances of cholecystitis had spasm of the pyloric zone chiefly, but also of the second and third portions of the duodenum. These have been verified by Bryant of Boston. Anybody can then see how difficult it is to exclude these instances of cholecystitis with involvement of the pyloric zone by the roentgenoscopic examination.

Furthermore, it was shown at that time that in considerably more than fifty-one per cent of instances of ulcer of the duodenum and ulcer of the stomach we had cholecystitis coincident. It is evident how frequently deformity and abnormal rates of peristalsis or faulty emptying of the stomach may occur, due to the spasm from a cholecystitis.

In the cases where we have a great deal of scar tissue, it seems necessary to emphasize that these patients should not be condemned as having ulcer or not having ulcer upon one examination. If it is doubtful they should return very frequently for examination before condemned as having ulcer. They have a great dread of it. It is not as interesting to the patient as to the doctor.

We have followed a routine which has proved satisfactory. The records are made on the properly prepared patients after the fashion outlined by Dr. Carman. If there is a suspicion of duodenal disease or pyloric disease, these patients are thoroughly saturated with belladonna or atropin, usually over several days, and returned for comparative study. In this way it is possible to segregate from the subacute or acute ulcerations many cases, which at first might be considered as having real deformity, and class these as instances of lesions which are not ulcer.

In the group complicated by periduodenal adhesions Polesky of New York said the plate may be made with a duodenal tube in position; that one can by noticing the variation in the position or the curve or the angulation of this tube from time to time, with the patient in different positions, estimate how much fixation there may be in or

about the duodenum. A very simple means, one possibly as accurate, is a rather heavy string of cord saturated with bismuth or barium, which carries on the end a small slug. This will follow the tract of the duodenum quite as closely as Polesky's tube. Plates indicate very little unless they are made comparatively. They indicate little, indeed, in the ulcers not accompanied by great deformity. Serial plates indicate little unless different series are compared. Many times patients are treated for ulcer and everybody is disappointed when somebody comes along and takes out two or three gall stones, a foul gall bladder or removes an appendix. These points have come to my mind.

I will say in my own clinic and in my own mind the roentgen diagnosis of the non-deforming ulcer of the duodenum is an extremely difficult job. It is frequently impossible, and only when the roentgen findings are in association with thorough, careful, detailed clinical history, can we attempt to make a diagnosis. (Applause).

DR. BERTRAM W. SIPPY *(Chicago)*: I am sure that I can say without fear of injuring the feeling of any one that, for obvious reasons, Dr. Carman knows more and should know more, and actually does know more than any one in the world about the roentgenological evidence of duodenal ulcer. We know that he is full of his subject. I would like to give my time to him. I know that he is willing to talk and I feel that he is not exhausted.

With this brief remark I expected to sit down. I would do so except for one thing, and that is that I must rise to the defense of accurate history, accurate study by other means than the roentgen ray to avoid error in diagnosis. It is commonly, among the surgeons particularly, stated that in the diagnosis of duodenal ulcer, clinical history comes first, roentgenological examination second, laboratory and other methods third and fourth.

When the laboratory methods consist in making a test meal, giving a test breakfast and determining acidity, a few little perfunctory things of that sort, we may agree that clinical history comes first, roentgenological examinations second and laboratory and other methods third and fourth.

In our work this is the way we look upon it. Of enormous importance is clinical history first, accurately taken. That clinical history becomes of great importance only when it is determined that the clinical history is correct and the man making it has observed accurately. This can only be done by a period of observation, which does not take long. The patients will not come to you unless they have a distressed symptomatology.

If a history is obtained at this time by one who knows how to do it, then we place clinical history first, backed up by the conviction that the history has been given correctly, that it has been observed correctly. Then the clinical history becomes of enormous importance, of greater value in a great many cases than roentgenological findings.

In our work we do not have the x-ray examination made first. We get the clinical history. If there is nothing urgent about it, we study the case and determine whether the clinical history is right by having the patient under observation. If there is no contra-indication, and there seldom is, we give these patients three ordinary meals daily. We determine then whether distress is present. They won't come to you if the distress is entirely absent. When they come to you give them three meals a day, then observe whether the distress comes on immediately upon eating. If it does, it will rarely be attributable to ulcer. They may have distress in something else and still have an ulcer. It may come on at a period after eating. Distress to be attributable to ulcer does not come on immediately upon eating nor immediately after. When there is no obstruction present or perigastritis or other lesion to make the pain come earlier, it comes as a rule not much earlier than an hour or hour and a half after eating. When it appears it is a continuous distress. It may fluctuate in severity but seldom becomes intermittent. At the end of three hours it is not gone. It may continue until the next meal to be relieved by eating. This is observed accurately as to the time of appearance of distress. That is one of the most constant and reliable things we have to deal with in diagnosis.

I wish it were better known that when those symptoms appear they may be made to disappear under the influence of manipulations. They are so constant that when carefully studied there can be no incompatibility with certain things in relation to the symptomatology. We tried to bring that out briefly in Oxford Medicine if any of you care to know how we feel about it. We cannot talk about it here fully. There are five things that permit of no incompatibility: Epigastric distress of any sort, time relation to food taking, relief from adequate food taking. Often taking a cracker brings temporary relief. That may be permanent, but is seldom so. On taking a given meal consisting of an egg or two or steak or bread and butter with cereal, making two-thirds of an ordinary meal having a good deal of albumin in it, the distress attributable to ulcer will be temporarily relieved for a period of an hour or two. The distress not relieved by food taking may not be attributable to ulcer. Distress is also relieved by adequate alkali. For a distress supposed to be ulcer distress, for adequate alkali test powder we use thirty grains of calcium magnesia and thirty grains of soda. Distress is relieved, and a distress unrelieved by that type of powder will rarely if ever be attributable to ulcer. Distress is sometimes present when the stomach should be emptied, say one or two o'clock in the morning. The patient says "I am awakened at one or two in the morning." A tube should be used at that time to see whether he has an adequate content to permit of that type of distress being due to ulcer.

When all of the clinical history runs true, if you find the man is having the usual distress, and you go in with the tube you will find he has the contents of the normal fasting stomach, that is, five, ten, fifteen, twenty cc. The man is sure that is his usual distress. This is one of the important symptoms of obstructive ulcer. That is what we mean by laboratory work, not simply taking the test breakfast, depending on the degree of acidity as to what is wrong.

I firmly believe that it is wrong teaching to separate accurate clinical study from the roentgenological evidence. I feel that the maximum benefit in diagnosis can be obtained only by a careful use of clinical signs in association with the best roentgenological findings. I would not speak if it were not to emphasize that point. I do not imagine that the cases go to the Mayo Clinic stamped as eight years old or older. I do not imagine they have to deal always with an *old* ulcer. Cases go to them as they come to us and to all individuals doing this work. They have no corner on the old cases. Therefore, what he says will be applicable to the type of cases we all get. They get the same cases we get. They are probably no different.

DR. WALTER W. HAMBURGER *(Chicago)*: I enjoyed Dr. Carman's paper tremendously. I like particularly his method of study, his way of showing objectively his x-ray findings then checking them up with the surgical findings at the time of operation. That is an ideal way to study x-ray statistics. I feel as Dr. Sippy does. I do not want to take much of Dr. Carman's time. I want to emphasize the one point that both clinical and x-ray examinations should be made. I think perhaps it is wrong to make the statement, "Roent-

gen Diagnosis of Duodenal Ulcer." Is there such a thing? Would it be better stated to say "Roentgen Findings"? If the diagnosis is a clinical diagnosis of a clinical disease, physical findings, x-ray laboratory findings and at times history should be taken.

At my clinic, our procedure is a careful history taken as Dr. Sippy outlines careful physical examination, laboratory work and finally x-ray. As Dr. Smithies pointed out, controlling x-ray findings of same with atropin to be sure that the defects are not spastic but are organic.

Several years ago we were interested in the gross defects and relation of the gross defects of the duodenal cap to motility and influence of treatment. We proved later in operation that the clover leaf projections Dr. Carman showed are more scar tissue than granulation tissue or evidence of acute ulcer. The duodenal cap does not show whether the ulcer is active or whether there is simply scar tissue in the duodenal bulb causing those findings. Unless you correlate clinical evidence of activity of ulcer it does not make much difference whether you diagnose duodenal defect or not. It is not parallel with interference of motility. It may not interfere with the emptying time of the stomach.

The point was raised as to how many individuals without gastric symptoms of any sort might show duodenal defects, not relieved by atropin. I would appreciate it if Dr. Carman has anything to say along that line. It may be in some of his cases of positive findings with negative surgical findings they would fall into that group. Simple finding of cloverleaf groups without clinical evidence does not mean much.

I would be interested in looking through with x-ray a hundred individuals with defects we are calling ulcer. I want to say a word about the point I made, namely, that duodenal defects may not be associated with active ulcer. We have a fewer number of cases, somewhat, with a normal contour, which at operation showed a gross duodenal ulcer.

I am thinking of a man of fifty-five, a patient whose report I had published in North American Clinics a year ago. He had gall-bladder disease and a large duodenal ulcer in the posterior wall of the abdomen. We had no clinical evidence, and no x-ray evidence. These two conditions are mutually opposite. I would like to make that point clear. In the first group evidence of defect is constant under atropin without ulcer being present, without signs of activity, with no abdominal signs or complaints. In the other type the x- ray shows a normal contour in the bulb and ulcer is found at operation.

I want to state my appreciation of Dr. Carman's paper.

DR. LEWIS GREGORY COLE *(New York City)*: I was not on the program to discuss this subject, but it does give me the greatest amount of pleasure to corroborate every single statement that the speaker on this subject has made. (Applause). I think that he is attempting to do something which I do not believe that I can do. I have not tried to do it in the past and I do not believe I shall try to do it in the future.

There are approximately ten or twelve or perhaps fifteen per cent of the cases where we must content ourselves with a positive diagnosis of an organic lesion involving the cap.

The reports are worded in that form and then they go on to say that the deformity may be due either to the cicatrical contraction of the scar of an ulcer or to gall-bladder adhesions, the weight of the evidence being in favor of one or in favor of the other, and when we content ourselves with that, which I believe is a thoroughly practical statement, we will have eliminated all but three of the errors which Dr. Carman reported.

I would like to know of any other branch of medicine—I would like to know of any other method of examination, of any other disease, where the accurate diagnosis can be made in five hundred and twenty cases out of five hundred and twenty-three. (Applause).

Dr. Sippy and Dr. Smithies, I wonder, if by all other methods combined in clinical history and physical examinations, how happy you would be if in the years that had gone by or the years that come, you could make five hundred and twenty accurate diagnoses out of five hundred and twenty-three? (Applause).

DR. SETH HIRSCH *(New York City)*: My contribution in tonight's symposium will be but to pay homage and tribute to the skill and dexterity and keenness of vision of my friend, Dr. Carman, and to pay a just compliment to Dr. Cole, who first described the peculiar deformity of the duodenum.

It is a pathognomonic sign. It is because of Dr. Cole's insistence that this deformity was characteristic of duodenal ulcer in the vast majority of cases and periduodenal disease in the remaining number of cases that the former triad of indirect signs so-called hyper-peristalsis, hypertonia and hypermotility have become comparatively unimportant. I must admit for a long time the morphological changes as balanced against the motility changes and indirect signs were constantly discussed, but now the statistics bear out the truth of Dr. Cole's claims, and it is time that that be admitted. Thank you. (Applause).

DR. ARIAL WELLINGTON GEORGE *(Boston, Mass.)*: I think I can say with Dr. Cole and Dr. Hirsch that it has been a great pleasure to hear Dr. Carman tonight, to see some of the errors he has made and appreciate that we are making the same sort of errors.

The percentages that he gives us are very reasonable and it pleases me more than ever tonight to know that some of our best internists in this country have heard Dr. Carman, and they must feel that in the hands of men such as Dr. Carman and Dr. Cole, roentgenology has reached a very accurate stage.

There is just one point that I would like to bring up. There are very few men in this country today who can do fluoroscopic work as Dr. Carman. If I had to read a paper such as Dr. Carman read tonight, I would say that the first source of error that would come to me would be the use of the fluoroscope versus plate method.

We are not concerned so much with the minute changes in the duodenum, we are more concerned whether there is a lesion of the duodenum. It is of no great concern whether it is a lesion of ulcer or adhesion of the gall-bladder. The man will have some suspicion that there is a lesion of the gall-bladder. I want to thank Dr. Carman for showing us these plates which he has tonight.

DR. CRANE: Dr. Sippy when he arose stated that no one knew as much about roentgen diagnosis of duodenal ulcer as Dr. Carman. We may say with equal accuracy that no one in the world knows more of the clinical symptomatology of ulcer than Dr. Sippy. (Applause). Any one who would take the pains to read the splendid contribution he has made in Oxford Medicine would be convinced of this. We may notice, however, in this article of Dr. Sippy's in Oxford Medicine he speaks of the diagnosis of gastric ulcer from the clinical symptomatology to include duodenal and gastric ulcer. It was not undertaken to distinguish whether the ulcer was in the duodenum or the stomach, from the symptomatology. That is as true today as it was in the time of Moynihan. The x-ray, therefore, is pre-eminent in its ability to distinguish between duodenal and gastric ulcer. We may say, in fact, that until the opaque meal was used, this differential diagnosis was almost if not quite impossible in the majority of cases.

The duodenal cap deformity which is so characteristic of the x-ray exam-

inations may be due to many possible conditions aside from ulcer, but they are not common. If we have a cap deformity without a symptomatology, we would have to have what is known as a latent ulcer.

Dr. Sippy in his recent contribution brings out sharply the fact that if we have latent ulcer we have ulcer without hyperacidity. At least I so understood it. I see he shakes his head. It is my belief, however, that without hyperacidity we do not get the epigastric pain in duodenal ulcer. I have had occasion lately to go over one thousand cases of gastric analysis made in our laboratory and I have been greatly impressed with the importance of a hyperacidity in the diagnosis of duodenal ulcer.

In no case of achylia have we been able to diagnose a duodenal ulcer. In the vast majority of cases the hyperacidity is present and I greatly deplore the neglect into which the gastric analysis has gone.

I believe what Dr. Sippy says and what Dr. Hamburger has said may be taken to heart, that is that the roentgenologist can do well to consider carefully the clinical history of the case before he translates his roentgen findings into the terms of a clinical diagnosis.

DR. CARMAN: I think that the wisest thing for me to do is to thank these gentlemen and sit down. However, I might mention one or two things. When I first went to Rochester, nine years ago, I was very much interested in the history of the case to go along with our roentgen work. In other words, it was quite a comfort when we had made a diagnosis of duodenal ulcer to know that the patient had a fairly good clinical history. It was a good balance so long as we were making the correlation. If the clinician is going to make the correlation, it is a different proposition. If you can tell him what you have and he makes the correlation, it does not do any harm. If you make the correlation, it works harm. We have clinical men who examine the patient, come to the x-ray department and want us to agree with their findings. We cannot do it. If we did we would find that we would lose our position in all probability. This applies more to gastro-intestinal work than to any other part of the human body. If we were going to make a diagnosis of a bone or chest condition, I would want to know something about the clinical side of the case. In gastro-intestinal work I feel it is not necessary.

About the groups that Dr. Smithies mentioned, I feel as does Dr. Sippy, that we see the same cases that Dr. Smithies sees and that Dr. Sippy sees. There was no special group considered in this series—just a year's work, and the cases were from the smallest type of ulcer up to the very large. I think that is all. I thank you. (Applause).

Practical Applications of Ionization Measurements of X-Rays*

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THE conclusions drawn from the following experiments are based on three assumptions, first, that the principle of the theory of homogeneous radiation as advanced by Dessauer in 1912, is correct; second, that the ionizing effect and the physiologic effect of x-rays are somewhere near the same; and, third, that the absorption and scattering rate of x-rays in water approximates roughly the rate in human tissue.

If we are willing to assume further that the action of x-rays on deep-seated lesions is the same as it must be on superficial lesions, that is, purely destructive, we can readily see that our problem in deep therapy is to deliver a sufficiently large dose to the deeper structures of the body without injuring the skin. If we are to use only two portals of entry, the front and back, for instance, it is obvious that we must use a technique giving a skin depth ratio of two to one, or one which will deliver at least fifty per cent of the skin dose to the center of the body. Taking the average distance from the skin to the center of the body as ten cm. we performed our experiments with a view toward determining the effect of various changes in the factors of technique on the ratio between the surface and depth dose, making the readings at the surface of a water phantom and at a depth of ten cm. beneath the surface of the water. The results of our experiments showed, as we expected, and as has often been shown before, that increasing the voltage, size of fields, anode-surface distance and thickness of filter, lessened the surface depth ratio, or to express it differently, that increasing the four factors (voltage, size of fields, anode-surface distance, and thickness of filter) also increased the percentage of radiation delivered to the depth. They also showed that there seems to be a definite mathematical relation between these four factors, and that there is a limit to the economical increase of all of them except voltage.

It is obvious that increasing the anode-skin distance from twenty centimeters to forty centimeters, and the filter from a single thickness of sole leather to one-fourth millimeter of copper, for instance, will improve the surface depth ratio more than enough to compensate for the increase in the time required to administer a dose. It is equally apparent, that with our present apparatus, to increase the anode-skin distance to two hundred cm., and the filter to three millimeters of copper, would be absurd. There must be a limit somewhere. The object of this report is to call attention to the possibility of establishing points beyond which increase in the size of fields, anode-skin distance and thickness of filters is no longer economical.

The first measuring apparatus which we constructed was crude, being made from an old cigarette box, a salvarsan can, a length of gas tubing and a piece of lead pipe. A microscope with a scale on the objective was mounted opposite the windows in the tin can electroscope in order that the rate of fall of the gold leaf might be observed and recorded by means of a stop-watch. The electroscope was connected to the ionization chamber by an enameled copper wire mounted in sulphur at the ends and supported by cylinders of paraffin in the metal tubing. This electroscope discharged ten small units in seven minutes, so that it was necessary to make a correction for the readings obtained.

Fig. 1 shows a photograph of a newer measuring apparatus in which the electroscope is more completely enclosed by metal and the copper wire is supported by sulphur cylinders throughout. This instrument will normally discharge ten small units on the scale in about three hours and can be used without making a correction for the normal fall. The tank is of such size that it can be carried in a hand bag. The ionization chamber is mounted on half inch pipe tightly screwed together so that it can be

*—Read at the Meeting of the Chicago Roentgen Society, March 24, 1922.

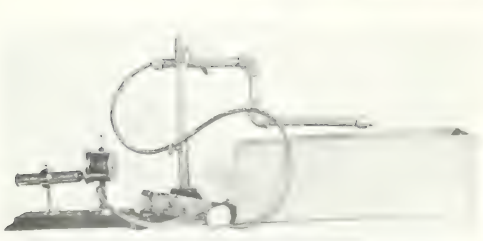


Figure I.—Photograph of Measuring Apparatus.

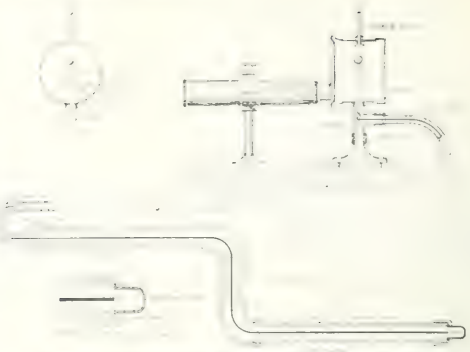


Figure II.—Diagram of Measuring Apparatus.

immersed in water without any danger of the inside of the chamber becoming damp.

The following results obtained from measurements of the surface and depth doses with the technique used in my office two years ago, will illustrate the methods used in accumulating the data. The fixed factors were 140 kv. 5 ma., anode-surface distance 22.5 cm., surface depth distance 10 cm., and diameter of field 7.5 cm. The average number of seconds required to discharge ten small units on the scale with the ionization chamber at the surface of the water was 2.9, while the average number of seconds required to discharge ten small units on the scale with the ionization chamber at the depth of 10 cm. was 16.2. By dividing 2.9 into 16.2 we see that the ratio between the surface dose and the depth dose is as 5.6 is to 1, or by dividing 16.2 into 2.9 we can show that the percentage of the entire beam of x-rays delivered to a depth of 10 cm. is only 17.9.

In order to learn whether x-ray dosage can properly be expressed in terms of electrical measurements we made readings with different machines on different dates under conditions as nearly identical as it was possible to produce. Where it was possible to measure voltage by means of a sphere gap the results were nearly constant.

It will be seen from these data that not only does the time required to give the surface and depth dose diminish as the voltage is increased, but that the ratio between the surface and depth dose diminishes with each increase in voltage. For example, at 140 kv. it requires 23 seconds to produce a fall of ten small units on the scale with the ionization chamber at the surface, and 57 seconds to produce the same effect with the ionization chamber at a depth of 10 cm., giving a ratio of 2.48, or a percentage of 40. If the voltage is increased to 220 kv. it only requires 9.6 seconds to produce the same discharge at the surface and 20 seconds at the depth, giving a ratio of about 2 and a percentage of about 50. In other words, by increasing the voltage from 140 to 220 we have not only succeeded in delivering 50 per cent of the total radiation to the depth instead of 40 per cent, but we have also reduced the necessary time of exposure from 230 units of time to 96 units.

Fig. 3 shows curves plotted to show the surface and depth doses at various voltages. It will be seen that not only does the time required to produce a given effect diminish with each increase in voltage, but that the lines also approach each other. It seems proper to conclude, therefore, that voltage should be increased to the limit of the capacity of the apparatus.

VARIATIONS IN VOLTAGE

Ma., 3.5. Filter Al., 1.0. Cu., 0.5 mm.
Anode to Surface, 50 cm. Surface to Depth, 10 cm. Full Field.

Kilovolts Maximum	Seconds to Discharge at Surface	Seconds to Discharge at Depth	Ratio	Per Cent
100	57.2	188	3.3	30.4
120	37.1	101	2.8	36.7
140	23.0	57.0	2.48	40.3
160	17.7	41.6	2.37	42.5
180	13.1	30.0	2.3	43.6
200	9.8	21.7	2.2	45.1
220	9.6	20.0	2.1	48

Before making a study of the effect of variation in the size of fields, we made a few measurements of comparative intensities at different parts of the field as defined by an ordinary tube-stand and found that there is not much difference at various points in such a field when the measurements are made in air. Other measurements made with the ionization chamber at the surface of water apparently showed that the intensity is much greater at the center of the field. When the ionization chamber was exposed through a small opening in a lead screen, the measurements in different parts of the field again became nearly equal, showing that the apparent greater intensity at the center of the field is due largely to secondary radiation in the water. We accordingly assumed that the intensity in all parts of the field as defined by the opening in the bottom of an ordinary tube-stand is sufficiently uniform that the whole beam may be used if desired.

It will be seen that the ratio is lessened with each increase in the size of the field and that the time required for the surface dose is also lessened with each increase in the size of the field.

Fig. 4 shows graphs of the surface dose, the per cent delivered to a depth of ten cm., and the ratio for variations in the size of the field. There is a very considerable drop, both in the surface dose and in the ratio with each increase in the size of the fields up to fifteen by fifteen cm., after which both curves flatten out. We may con-

VARIATIONS IN SIZE OF FIELDS

Kv., 140. Ma., 4. Filter, Al., 1.0. Cu., 0.25 mm.
Anode to Surface, 40 cm. Anode to Depth, 50 cm.

Size of Fields in cm.	Seconds to Discharge at Surface	Seconds to Discharge at Depth	Ratio	Per Cent
2.5x2.5	12.3	59.5	4.84	20.7
5x5	11.5	45.0	3.91	25.5
10x10	10.2	33.6	3.3	30.3
15x15	9.7	31.2	3.21	31.0
20x20	9.6	30.0	3.1	32.0

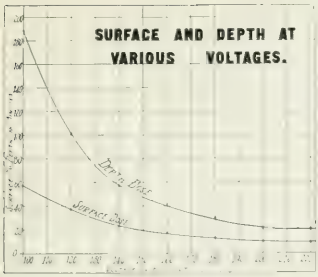


Figure III.—Graphs of the discharge in seconds at the surface of water and depth of 10 cm. with various voltages.

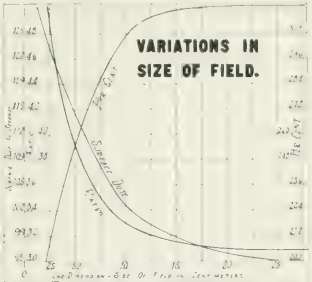


Figure IV.—Graphs of the discharge in seconds at the surface of water, the surface-depth ratio, and the per cent at a depth of 10 cm., with various sizes of field.

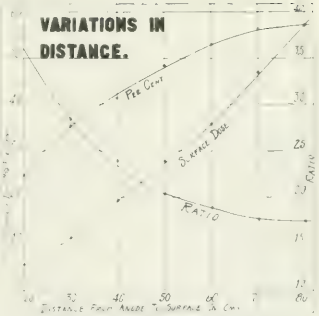


Figure V.—Graphs of the discharge in seconds at the surface of water, the surface-depth ratio, and the per cent at a depth of 10 cm., with variation in distance and size of fields.

VARIATIONS IN DISTANCE AND SIZE OF FIELDS

Kv. 140, Ma. 3. Full Field, Filter Al. 1.0, Cu. 0.5, Surface Depth, 10 cm.

Anode Distance in cm.	Surface Seconds to Discharge at Surface	Seconds to Discharge at Depth	Ratio	Per Cent
20	5.5	20.9	3.61	25.3
30	11.2	31.9	2.84	35.1
40	19.4	47.1	2.43	41.2
50	28.0	56.9	2.03	49.2
60	35.7	68.0	1.9	52.5
70	46.7	82.0	1.76	56.3
80	56.7	99.6	1.75	56.9

clude from the data and graphs that the size of fields should be at least fifteen cm. square.

The following data is for variations in distance and size of fields combined, that is, the full field was used and naturally increased in size as the anode surface distance was increased.

With each increase in anode-surface distance the ratio is lessened, but the time required to give the surface dose is increased. The question that arises, then, is at what point does economical increase in anode-surface distance end?

Fig. 5 shows graphs of the surface dose, surface depth ratio, and per cent delivered to the depth, for variations in distance and size of field. Examination of the graph of the surface dose shows that it is a straight line, which is what we would expect. A break occurs in the graphs of the surface depth ratio and per cent somewhere between forty and fifty cm. A search for an explanation of this break showed that at a distance of about forty cm. the field became so large that it extended beyond the walls of the tank, and after this the lessening effect on the surface depth ratio of the increasing size of field was no longer obtained.

When x-rays are administered through small fields, the center of each field is the base of a pyramid of tissue which receives a progressively smaller percentage of the skin dose as depth increases. The corner of a field where it joins the three adjacent fields is the apex of a pyramid which a short distance under the skin receives almost four times the skin dose. If instead of treating four small fields the tube be removed to twice the distance and a single field, covering the same area as the four small fields, be given one treatment four times as long as a single small area, it is evident that the skin dose will be the same. The total amount of radiation received by the body will also be the same. It will, however, be more evenly distributed

VARIATIONS IN FILTER

Ma., 5. Diameter of Field, 10 cm.
Anode Surface Distance, 50 cm. Anode Depth Distance, 60 cm.

Kilovolts (Maximum)	Filter in mm. Copper	Seconds to Discharge at Surface	Seconds to Discharge at Depth	Ratio	Per Cent
75	None	15.9	225	14.15	7
75	.065	37.8	304	8.04	12.46
75	.103	52.2	355	6.8	15
75	.134	66.4	404	6.09	16.4
75	.268	135.6	609	4.2	22.26
75	.536	335.6	960	2.86	35
75	.768	603.2	1583	2.45	38.02
102	None	7.6	54.2	7.14	14
102	.065	14.0	66.0	4.7	21.2
102	.103	17.5	73.4	4.19	23.8
102	.134	19.9	76.0	3.82	26.2
102	.268	32.9	104.0	3.16	31.6
102	.536	66.0	164.4	2.71	36.9
102	.768	96.2	233.2	2.42	41.2
133	None	5.4	33.3	6.16	16.21
133	.065	9.3	40.2	4.32	23.13
133	.103	11.5	42.0	3.63	27.5
133	.134	11.8	44.4	3.56	28.1
133	.263	17.9	54.4	3.0	34.7
133	.536	30.2	75.8	2.51	40 0
133	.768	43.1	96.8	2.24	44.6
170	None	4.05	20.1	4.96	20.14
170	.065	6.46	22.3	3.44	29.05
170	.103	7.9	26.8	3.89	29.47
170	.134	9.05	28.5	3.16	30.79
170	.268	12.0	32.7	2.72	36.69
170	.536	18.0	42.3	2.35	43.73
170	.768	21.9	47.7	2.17	45.91
210	None	2.77	11.55	4.16	24.0
210	.065	4.36	13.8	3.17	31.5
210	.103	5.0	14.8	2.96	33.7
210	.134	5.93	16.1	2.71	26 8
210	.268	7.65	18.75	2.45	40.8
210	.536	9.85	22.9	2.33	43.0
210	.768	12.0	24.4	2.0	49.0

Figure VI.—Graphs of the per cent of the entire radiation delivered to a depth of 10 cm. in water, and the time required for discharge at the surface, with variations in filter thickness and various voltages.

and there will be a substantial drop in the surface depth ratio due to the lessened divergence of the rays at the greater distance. If the tube be removed to three times the distance it will be necessary to make an exposure nine times as long in order to get the same effect on the skin. In this case, however, the part of the beam falling outside of the body will be wasted and the increase in distance will be no longer economical. We may conclude, therefore, that the anode-surface distance should be just great enough to permit the entire surface to be treated at one time, which, with the usual type of tube stand, and the average sized patient, will be somewhere between fifty and sixty cm.

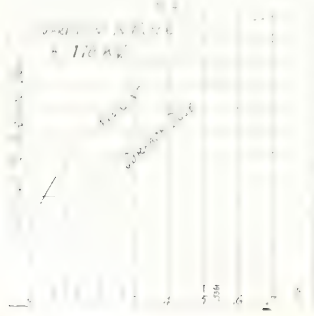
The following data were obtained by using increasing thickness of copper filter with various voltages. Because of the difficulty of obtaining anything but very small pieces of uniformly thin copper, these readings were made in a field only ten centimeters in diameter, and the percentages are somewhat less than they would have been had a full field been used.

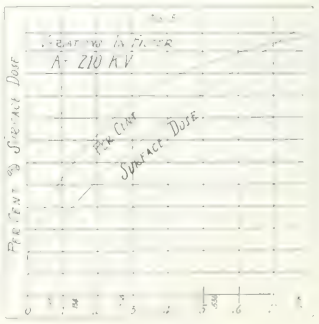
In Fig. 6 the per cent of the total amount of x-rays reaching a depth of ten cm. in water, with increasing thicknesses of filter, and five different voltages, is plotted against the time required for the discharge at the surface on an arbitrary scale. Especially with the lower voltages, the rise is considerable in the first portion of the per cent curves, corresponding to the introduction of the first few layers of filter. With each increase in voltage, the region in which the per cent curve tends to become parallel to the surface dose curve, corresponds to a greater thickness of filter.

Fig. 7 shows the graphs of the surface depth ratios produced by variable thicknesses of filters at voltages of 75, 102, 133, 170 and 210 kv., all plotted on the same scale to show the flattening of the curve with each increase in voltage. The thickness of filter required to produce a given ratio diminishes as voltage is increased. For instance, a ratio of four to one can be obtained with 75 kv. by using 0.3 mm. copper; with 102 kv. by using .125 mm. copper; with 133 kv. by using 0.1 mm. copper; with 170 kv. by using .05 mm. copper; while with 210 kv. it is only necessary to use about .01 mm. copper.

Fig. 7 also shows that with a given thickness of filter, the ratio becomes less with each increase in voltage. For example, with a filter of .134 of copper, the ratio with 75 kv. is 6; with 102 kv., 3.8; with 133 kv., 3.4; with 170 kv., 3, and with 210 kv., 2.7. While Fig. 7 shows that fairly low ratios may be obtained even with low voltages, by increasing the thickness of the filter, it does not show the tremendous increase in the time required for the surface dose. By referring to the data we see that with low voltages and thick filters it is necessary to extend the time of exposure beyond the limits of economy, or, in other words, it is necessary to remove too great a proportion of the beam of rays.

Fig. 8 shows the relative length of time required for the surface dose with the five voltages and various thicknesses of filters. The height represents time, and the width represents thickness of copper. This illustration shows that the introduction of filters lengthens the time required for the surface dose much more, proportionately, with the lower than the higher voltages. It also shows the proportion of all x-rays removed by the different thicknesses of filter. For example, with 133 kv. it requires 5.4 seconds to give a surface dose when no filter is used. When sufficient filter has been introduced to require twice this time, or 10.8 seconds for the surface dose, it is evident that half the beam has been absorbed. The amount of copper necessary to absorb half the beam produced by 133 kv., is, therefore, seen to be about .125 mm. When sufficient filter is introduced to necessitate four times as long an exposure as the unfiltered dose, it is evident that three-fourths of the total beam has been absorbed. With 133 kv., three-fourths of the beam is absorbed by a little less than four-tenths mm. of copper. In the same way the three-fourths absorption values are shown for the other voltages. By referring to the data we find that the limit of economical increase in thickness of filter follows fairly closely the three-fourths absorption value. We may conclude, therefore, that with 133 to 140 kv., which is approximately the voltage that most of us are using at this time, the limit of economical thickness of filter is approximately 0.4 mm. of copper, and that with 200 to 220 kv. the limit is somewhere near .75 mm. of copper.





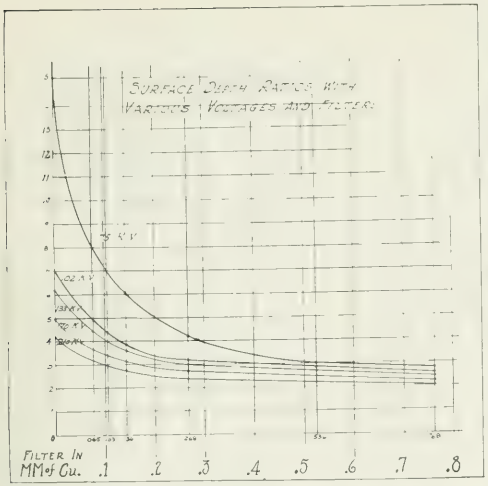


Figure VII.—Curves showing surface-depth ratios obtained with various voltages and filters.

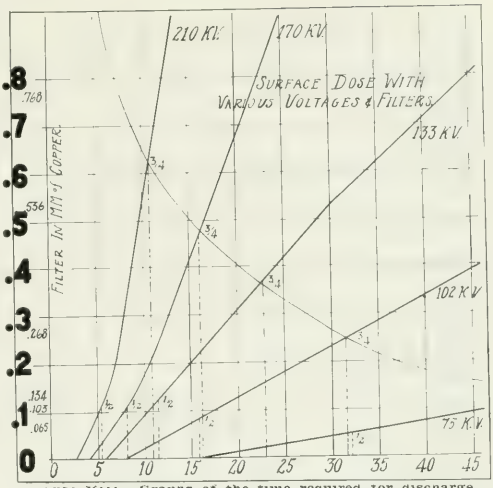


Figure VIII.—Graphs of the time required for discharge at the surface with various voltages and filters. The relatively small half-absorption values with 210 and 170 kv. are due to tehcnical errors. The lines should be nearly straight.

Summary

1. Increasing voltage lowers the surface depth ratio and lessens the time required for the administration of a given dose. The limit of desirable increase in voltage is the capacity of the apparatus.

2. The intensity of the whole field as defined by an ordinary tube-stand, is so nearly uniform that the entire beam may be used.

3. The size of the field should be at least fifteen cm. square.

4. The anode-skin distance should be just great enough to allow the entire surface to be treated at one time. With average sized patients the limit of economical increase in anode-skin distance is between fifty and sixty cm.

4. The limit of economical increase in filter thickness depends upon the voltage employed, and corresponds fairly closely to the thickness which will remove not much more than three-fourths of the entire beam of x-rays. With voltages between 130 and 140 kv., the limit is about 0.4 mm. of copper; and with 200 to 220 kv., the limit is about .75 mm. of copper.

My thanks are due to Dr. L. D. Weld of Coe College for many helpful suggestions, and to Mr. Scott Smith for his assistance in making the reading and plotting the curves.

Treatment of Malignant Neoplasms of the Tonsils*

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A review of the literature on new growths of the tonsil emphasizes several surprising features. Malignant tumors in this location are considered rare, and, with a few exceptions, reports are of individual cases. The question of diagnosis is uncertain in many reports. The opinion seems to prevail that carcinoma occupies a minor place in the entire group while a loose classification of sarcoma covers the majority of cases. In spite of its accessibility and early symptomatology the older methods of treatment have accomplished probably less here than in any of the intra-oral group of neoplasms.

In view of this it seems advisable to report on the results obtained to date with radium at the Memorial Hospital.

Because of the difficulty in deglutition, neoplasms of the tonsil are usually noted early, but, unfortunately, they rarely receive proper attention at this stage. Valuable time is usually lost in using local caustic applications followed by anti-syphilitic treatment and when these fail it is a common thing to find an incomplete tonsillectomy performed. The liberties taken with tonsillar ulcers seem out of proportion even to those taken with other intra-oral new growths. It frequently happens that a correct diagnosis is not made until the disease recurs locally or appears in the cervical nodes. The factor of error seems greatest in carcinoma of the tonsil. This is probably due to the fact that the ulcer is small and slow growing and that palpation, as a means of clinical examination, is seldom resorted to. This type of growth, however, predominates in older subjects, especially after the fourth decade. In young patients, lymphosarcoma is the most common neoplasm encountered. It assumes various atypical forms and hence we find in the literature many varieties of sarcoma reported in the tonsil. In fact, all of these probably belong to the group of lymphosarcomas or malignant granulomas.

The report and extensive resume made on this subject a few years ago by Matthews [1] is most instructive. He considers practically all cases surgically inoperable and points out that, even in cases apparently localized, the prompt recurrence following surgical removal indicates that infiltration at the base is more widespread than is apparent. This is especially true of lymphosarcoma.

*—Read at the Annual Meeting of The Radiological Society of North America, Chicago, Dec. 7, 1921.

Figure I.—Unfiltered tubes of radium emanation used for insertion interstitially.

Matthews concluded that, with the methods in practice at the time of his report, the cure of malignant disease of the tonsil was effected in only a small percentage of cases and that the operative procedures which promised most chance of cure were so extensive as to be attended with considerable mortality. This referred especially to lateral or external pharyngotomy. Of the more limited procedures he felt that tonsillectomy was of little value but that tonsillectomy plus cauterization gave a much better chance. With tonsillectomy alone, in twenty cases of sarcoma and three of carcinoma, most presumably early and favorable cases, not one was reported to have lived two years without recurrence, and only three (all sarcomas) were reported without recurrence at periods between six months and one year. He felt that in children, especially, radical treatment was of little avail and usually detrimental. Of cases treated by tonsillectomy and cautery he found fifteen reported cases with one free from recurrence after three years. In this group, Jacobson's [2] case is the longest reported without recurrence—eleven years. Of Matthews' own twenty-two cases, only a few of which came to operation, there were no cures. In his group of collected cases there were eighty-four of sarcoma. Of these eleven remained without recurrence six months to one year, five one to two years, six two to three years and one over three years. The case going over three years was the one treated by combined tonsillectomy and cautery. Of those between two and three years one was the result of combined tonsillectomy and cautery, four, lateral pharyngotomy, and one Coley's toxin without operation. In the collected group of twenty-three carcinomas he found one case without recurrence six months to one year, three cases one to two years and three over three years. Two of the cases over three years were by combined tonsillectomy and cautery. Coley's report in 1915 gave four cases, probably all lymphosarcoma, which remained [illegible] periods of one to eight and one-half years following the use of his toxin alone.

Of the other operative procedures practically no good results were reported. The method of exposure by cheek splitting gave no case over two years without recurrence. This method was probably not resorted to, however, except in very advanced cases. Dawbarn's method of ligating both external carotids and injecting paraffin into the vessel on the affected side gave no results worth mentioning. In Jacobson's report, the cures by open mouth methods are placed at ten per cent. This rate is, however, questionable because the time interval was short and the group of cases small. Matthews noted the palliative relief afforded by x-ray in some cases. Decrease in pain and retardation of growth were the benefits observed from this agent.

Various other observers have noted the palliative effects of x-ray, but all reports are of one or very few cases and no reported complete regression is of sufficient duration to make it of statistical value.

A few isolated reports are also to be found on the use of radium, either alone or in conjunction with x-ray. In these the time interval is short, and the final results inconclusive, except in so far as they relate to palliative relief. In a number of them the radium dosage was hopelessly small. A very recent report of a case by Perrier [3] is most interesting. He reports an extensive lymphosarcoma, treated by the Janeway [1] method of burying radium emanation in tubes, both in the tonsil and cervical nodes, and clinically free from disease at the time of his report—two months after the close of treatment.

This method of treating new growths of the tonsil with radium emanation buried interstitially was first introduced in our work over five years ago by the late Doctor H. H. Janeway and has proven of inestimable value.

It has been our experience that, in comparison with other intra-oral neoplasms, those of the tonsil are particularly susceptible to radium. This may be due to the fact that in young subjects the active lymphoid tissue exerts a strong defensive force, while in later

Figure II.—Trocar needles used for insertion of radium emanation tubes.

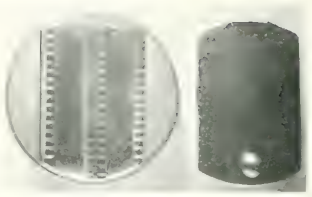

Figure III.—Two mm. brass tray to hold tubes for external application over the neck.

life the lack of blood supply and resultant tonsillar atrophy favors the action of radium. Once the disease has extended beyond the tonsil, however, the problem becomes more complex. The same cancer tissue seems to be influenced in its degree of malignancy by the nature of the soil in which it grows; the abundance of blood supply, freedom of movement and arrangement of anatomical planes seem to be the controlling factors in this apparent variation of growth.

As the disease advances in the tonsil one very common extension is that across the base of the anterior tonsillar pillar to the tongue. In this location it is quite as difficult to deal with as a primary carcinoma of the tongue. We feel that, in cases where this involvement is present when the patient is admitted to the service, the prognosis is only about fifty per cent as good as it would be were the disease confined entirely to the tonsil. Extension to the other adjacent structures—anterior tonsillar pillar, soft palate or lateral pharyngeal wall—is equally as complicating except in so far as the relative accessibility is concerned. In the tongue infiltration is deeper and more ill-defined. This is due to greater thickness of tissue, a rich blood supply and the free motion of that organ.

As for regional extension of the disease to cervical lymph nodes, we feel that this process is embolic, at least in so far as carcinoma is concerned. In view of this we have for the past few years divided the treatment of all intra-oral carcinoma into two stages—first, treatment of the primary growth, and second, treatment of the cervical nodes. In this report the same plan will be followed with exceptions made for lesions other than carcinoma.

I.—Treatment of the Primary Growth

We feel very strongly that all malignant neoplasms primary in the tonsil, unless very far advanced, should be treated by radium entirely. Furthermore, a clinical classification at the beginning of treatment should be made, based on the ultimate result to be hoped for. In other words, a distinction should be made between the case with possi-

bilities for complete regression of the disease and the other for which palliation only can be expected. Treatment should be given accordingly.

Some of the very far advanced cases should resort to medicinal measures rather than the physical agents for temporary relief.

Thorough and efficient radiation of a new growth of the tonsil designed to cause a complete regression of disease necessitates putting the patient through a painful period. Unless this complete regression can be reasonably expected, such a procedure is unwarranted. Hence the need for classification before beginning treatment. While the tonsil is readily exposed to vision, it is not so readily accessible to the older methods of radium application. Previous to 1916, when we were using only surface radiation we could do no more than give palliative relief. It is impractical to make an accurate and satisfactory surface application of radium to the tonsil for a period long enough to afford proper dosage. Even with radium tubes held in place by a hook at one end we were unable to maintain the accuracy and intimacy of application necessary for uniform results. However, as soon as we began the use of radium emanation buried interstitially our results at once improved. This method has been described several times before and needs only brief reference. Fine glass capillary tubes 0.3x3 mm. in size, containing radium emanation, are inserted at any desired depth in the neoplasm by means of trocar needles. Since this emanation decreases in value at the rate of approximately fifteen per cent per day, the total dosage to be derived from a given amount embedded can readily be calculated. The thin wall of the glass tube removes but little more than the alpha rays so that the total intensity of both beta and gamma rays is directed at the new growth. Apart from the ease of application there are several advantages in this method. Utilization of the beta radiation produces a very intense local effect. The tubes are held in place by the tissues and afford an excellent cross-fire of radiation. Radiation is evenly distributed, since the tubes can be buried at any desired depth; this is especially important in reaching the actively infiltrating base of a new growth. The slow prolonged radiation permits of greater dosage and is of further significance if malignant cells are more susceptible at the time of division.

The same method can be approximated by using thin metal needles containing radium salt buried interstitially. The chief disadvantages are the lesser amount of beta radiation obtained, the shorter exposure, smaller dose necessitated and the difficulty of retaining them in position.

We have never had trouble from the glass capillary tubes as foreign bodies. In solid tumors they become encysted by fibrous tissue excited to formation by the intense radium inflammation, while in more friable ulcerating lesions such as are usually found in the tonsil the majority of them probably slough out.

We have, however, had trouble from the amount of radium used per tube. In our earlier work with buried emanation we used tubes of three, four and even five millicuries each. These produced an unwarranted amount of sloughing with frequent resultant hemorrhages, to say nothing of the unnecessary suffering on the part of the patient. We now feel that tubes of one mc. each or thereabouts give best results. They occasion less sloughing and pain, and hemorrhage, which is still a factor to be watched for carefully in tonsillar work, is much less frequently encountered. Tubes of much less than one mc. do not afford enough gamma radiation to be efficient, unless a larger number are used. This traumatizes the tissues too much. In carcinoma, one millicurie of radium emanation per cubic centimeter of tumor tissue is approximately the required dosage. With lymphosarcoma or malignant granulomas, on the other hand, about one-half this amount is all that is usually required. It is always best to aim at complete regression from a single dose. It entails less suffering on the part of the patient, and, furthermore, a subsequent dose can never be as accurately placed because of the surrounding inflammatory tissue. The amount of fibrosis following the first massive dose renders a second dose less

Figure IV.—Three cm. block to afford uniform separation of brass tray from skin.

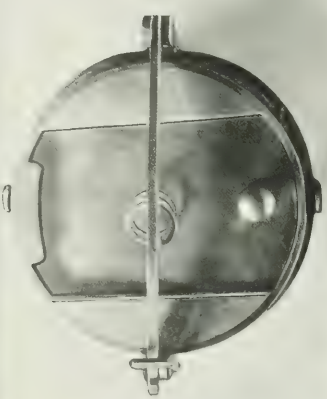

Figure V.—Brass tray clamped in place on block.

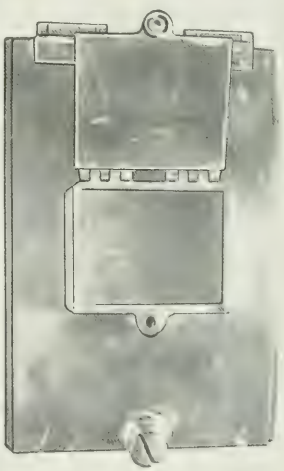

Figure VI.—Radium pack; two mm. brass filtration; for application at varying distances over cervical nodes.

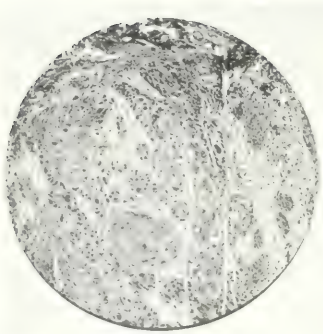

Figure VII.—Typical carcinoma of tonsil.

Figure VIII.—Typical squamous carcinoma of tonsil.

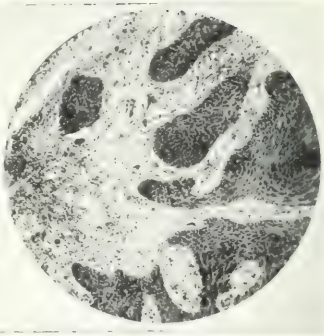

Figure IX.—Papillary acanthoma of tonsil.

effective and is more apt to be followed by hemorrhage from a rapid breaking down of this fibrous tissue. Wherever subsequent treatment is necessitated following an initial massive dose, the patient should be kept under close observation until all slough has separated or the external carotid artery should be ligated as a precaution.

Where treatment is to be given for palliative purposes only, much smaller amounts should be used and these can be supplemented from time to time without at any period exciting an extremely painful reaction. In treating these advanced cases care should always be taken to prevent making them worse rather than becoming too optimistic over faint possibilities of controlling the disease entirely and pushing treatment too radically.

In introducing the emanation tubes with trocar needles, care should be taken to make the distribution as accurate as possible with the greater concentration of dosage toward the base of the neoplasm rather than near its surface. Two points are of special importance in locating the tubes. One of these is at the base of the anterior tonsillar pillar to block off extension to the tongue. The other is the lowermost part of the lesion, which is frequently just out of sight unless the indirect method is used. Failure to place the emanation properly at this point may permit extension of the disease to the lateral pharyngeal wall or the extreme base of the tongue before it is recognized. In order to introduce the tubes more accurately here we use curved trocar needles and introduce them by the indirect method.

In the cases of recurrent new growths of the tonsil, which, unfortunately, we see only too frequently, the problem is very much altered and recurrence or implantation is usually at the periphery. In these cases the emanation tubes must be placed very widely.

The question of trauma must always be considered in using emanation tubes interstitially. Wherever possible a surface application of filtered radium should be used a few days before introducing the tubes. In the tonsil, this can be done very efficiently by placing heavily filtered radium over the tonsillar area, externally. Our own plan is to use two thousand to twenty-two hundred millicurie hours filtered by two mm. of brass and placed three mm. from the skin surface just posterior to the angle of the mandible. We feel that this renders emboli due to trauma much less harmful, thereby relieving in large measure the danger of introducing the trocar needle.

II.—Treatment of the Cervical Nodes

Since this phase of the work has been recently dealt with [15] in considering the treatment of the neck in all cases of intra-oral carcinoma, only brief mention of it will be made here.

Because of our belief in the embolic theory of extension of carcinoma to the cervical nodes, we have adopted an expectant plan of treatment, or rather, a combination of radiation and conservative surgery.

As soon as a case enters the service x-ray is applied to both sides of the neck and a heavily filtered tray of radium is placed over the tonsillar region, externally. If a definitely enlarged node is present in the neck the radium ray is used over this also. If the neck is free fram palpable involvement, x-ray is repeated at intervals over a period of several weeks. If surgically operable nodes are present at first, or appear subsequently, a complete unilateral block-dissection is done under local anaesthesia, two to six weeks following the external radiation, and radium emanation is buried at all suspicious points in the wound, especially where the lymphatic channels are severed. If the nodes be extensively involved in the beginning or are found at the time of operation to have invaded their capsule, no attempt is made to remove them, but emanation tubes are buried uniformly throughout the mass. We feel that it is best to expose such nodes surgically before burying the emanation because of the altered anatomy and because the tubes can be more accurately placed.

While external radiation produces marked inhibitory changes we have never seen complete destruction of epidermoid carcinoma metastatic in the cervical nodes from its use alone. On the other hand, we now have a small group of cases showing complete regression following the burying of emanation throughout the nodes in the manner just described.

In all cases where the neck structures are exposed surgically the external carotid artery on the side of the primary lesion should be ligated to prevent hemorrhage unless the primary site is entirely healed.

In dealing with the cervical extensions of lymphosarcoma or the malignant granulomas the physical agents alone should be used. Preferably this should be by a combination of x-ray over the surface and radium emanation interstitially. It should be stated most emphatically that surgery plays no part in the treatment of this group.

Statistics of Treated Cases

During the past five years we have treated one hundred and forty-nine cases of malignant neoplasms of the tonsil.

Many of these were very advanced cases, frequently recurrent after operation, and as we review the work three errors must be recognized, especially in the early part of the series. A large group of cases were so advanced that I am convinced they would have been better off had no radium been used. There comes a time in the course of the disease when medical measures give

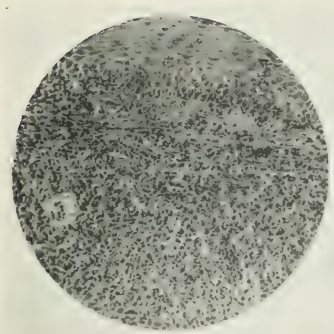

Figure X.—Lymphosarcoma of tonsil.

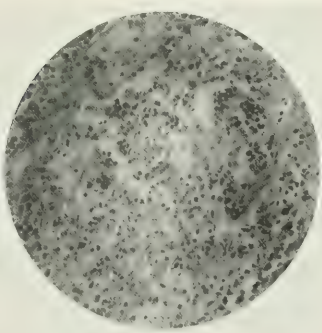

Figure XI.—Very cellular lymphosarcoma of tonsil.

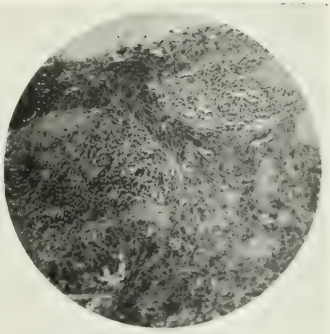

Figure XII.—Cellular carcinoma in lymph-node, untreated.

more relief than the physical agents Some cases which should have been classified for palliative treatment only were treated too vigorously in the hope of obtaining a complete regression of disease. In these, the treatment defeated its own purpose. In our earlier work with buried emanation the tubes used were for the most part too strong so that an unnecessary amount of suffering was produced to obtain a result which can now be attained with more comfort and less danger.

Our present follow up of these cases shows the following results. Of one hundred and twenty-four cases of carcinoma of the tonsil, twenty-eight cases are now clinically free from disease. Two other cases were free from clinical evidence of disease for fifteen months, at which time they were lost track of. Twenty cases at present under treatment are progressing favorably and a fair number at least bear promise of a complete clinical regression.

Forty-one cases were definitely improved for varying periods of time, but finally either died of the disease or are steadily becoming worse. Improvement in these cases means slowing up or definite regression of the growth, relief from pain, reduction in size of cervical nodes or prevention of their breaking down and fungating externally. Twenty-seven cases were absolutely unimproved by treatment and ten more were completely lost track of, so that they must be classified with those totally unimproved. Of the carcinomas, ten were recurrent cases, two of which were with recurrent cervical nodes and an unrecognized primary lesion in the tonsil.

Twenty-four cases belonged to the group of lymphosarcomas or malignant granulomas. It is my impression that a few more cases belonging in this group are filed under the general heading of lymphosarcoma and hence were inaccessible for this report. Of this group six cases are now free from clinical evidence of disease. One shows an excellent palliative result of over three years duration, but at no time has he been entirely free from clinical evidence of disease. Six of these cases were recurrent.

One case of rhinoscleroma of the tonsil is of interest. The patient has been under treatment for over three years, at times showing an apparent complete regression, only to reappear in some adjacent area of mucosa.

Of the twenty-eight cases of carcinoma of the tonsil reported clinically free from disease at present, the average duration since the initial treatment is twenty-six months. The longest period is fifty-six months and the most recent four months. In ten cases, neck operations, as previously described, were performed and in these the average duration is twenty-eight months. The oldest is fifty-six months and the most recent six months.

Another case, of interest from a palliative standpoint, was admitted eighteen months ago with an advanced primary growth and metastases in both sides of the neck. This patient has been treated by burying emanation, entirely, and while he has not a complete regression, there is nevertheless complete temporary control and no subjective symptoms. This case is cited simply as an example of palliative relief.

Of the lymphosarcomas or closely allied lesions one case has had a complete regression for over four years, another sixteen months, one twelve months, one eight months and two six months. Another case was lost track of a year and a half after treatment with complete regression at that time. One of the most interesting cases in this group is a patient in whom the tonsillar lesion cleared up promptly, but a large mass appeared in the neck and another in the lower left quadrant of the abdomen. Under heavy radiation these reduced somewhat and have remained stationary and quiescent without treatment for two years. His initial treatment was over three years ago.

In general, lymphosarcoma, because of its extremely cellular structure, responds very promptly to radium and

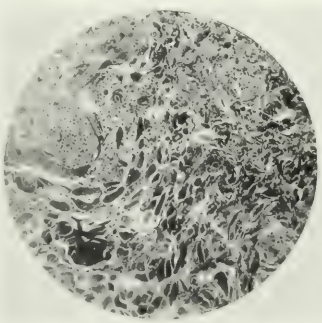

Figure XIII.—Lymph node invaded by carcinoma metastatic from tonsil, treated by heavy exter-radiation and removed surgically one month later.

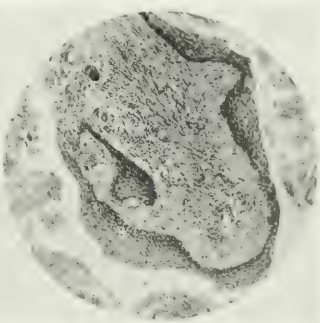

Figure XIV.—Lymph node invaded by carcinoma, treated by implantation of radium emanation bare tubes and removed surgically three weeks later.

the area treated tends for the most part to remain well, but dissemination is early and widespread and it is doubtful if many permanent results can be hoped for from radiation of the local process.

Conclusions

1. In all malignant neoplasms of the tonsil, radium is the agent of choice for treatment of the primary growth.

2. Best results can only be obtained in these cases by interstitial radiation—either by means of radium emanation or lightly filtered needles containing radium element embedded in the growth. This should be supplemented by heavily filtered external radiation—either x-rays or radium.

3. The treatment of cervical metastases of carcinoma of the tonsil is best managed by a combination of radium, x-ray and conservative surgery.

4. In lymphosarcoma or the malignant granulomas of the tonsil, surgery plays no part whatever. Metastases to the cervical nodes or elsewhere should be managed entirely by a combination of radium and x-rays.

Our experience with this group of cases encourages us to continue the plan of treatment along these lines.

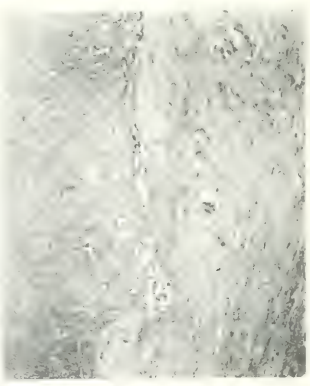

Figure XV.—Lymph node invaded by carcinoma, treated by imbedding of bare tubes of radium emanation, and removed surgically two months later. Note the complete replacement of carcinoma by fibrous tissue.

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Fractures of the Carpal Scaphoid

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FRACTURES of the carpal scaphoid were recognized only after wider use of the x-rays in injuries of the wrist. In pre-x-ray times diagnoses of "sprains" covered all carpal injuries, but thanks to the better study of these injuries with the aid of x-ray, fractures of the carpal scaphoid are at present recognized to constitute a clinical entity with characteristic symptomatology and physical findings.

Incidence

Up to about 1900 there was practically no literature on the subject. About 1910 various investigators reported the incidence of the carpal scaphoid fractures to be five-tenths per cent of all fractures, but in 1915 John B. Murphy [1] found this estimate too low and placed it at one to two per cent. He also found one fracture of the scaphoid to every ten, or fewer, of Colles' fractures. There is no doubt but that better diagnosis and a wider use of motor cars, the cranking of which has been an important causative agent of these fractures, are responsible for their increased frequency.

Fractures of the scaphoid are mainly incident to active and forceful manual work. Therefore, with the exception of cases produced by accidental falls, they are almost entirely limited to the male sex, to the age of greatest activity, that is, between eighteen and forty, to people actively engaged in manual work, and chiefly to the right hand.

Causes

The several fractures of the carpal scaphoid result from the application to the bone of, first, indirect violence, such as is produced by falls and backfiring of a motor while cranking, and, second, direct violence. The latter need not be discussed. Our discussion will, therefore, be limited to the former. A glance at the wrist of a skeleton will find the scaphoid occupying a buffer position between the lower end of the radius and the os magnum. Further examinatoin will reveal that the scaphoid is very tightly enclosed between the two stronger bones when the hand is abducted, that is, when deflected radially, while in adduction, that is, in the ulnar deflection position it is placed more radially to the outside of the carpus. Therefore, a force transmitted along the os magnum, scaphoid, and radius, particularly when the hand is in abduction, is likely to break the weakest one of the three, that is, the scaphoid.

Mechanism and Types of Fractures

John B. Murphy classifies the scaphoid fractures into three types:

(1) Simple transverse fracture produced by a force applied to the distal portion of the hand in the direction of the long axis of the radius, the same cause which at other times produces a Colles' fracture. It usually occurs in falls on the outstretched hand with the latter in the abducted position. The force is transmitted from the distal and palmar portion of the hand to the radius through the middle or thinnest portion of the scaphoid while the bone as a whole is tightly gripped and allowed no movement, so it naturally gives way producing a "snapped waist" fracture.

Speese [2] considers some of these fractures to be the result of compression of the weakest or middle portion of the scaphoid when forcibly jammed between the two stronger bones, as proximally it is applied against the radial styloid and distally it receives the os magnum as a wedge in its concavity.

The fracture usually occurs in the neck or waist of the bone. About sixty-six per cent of all scaphoid fractures are claimed by Alan H. Todd [5] to be of this type.

(2) Transverse fracture with impaction of fragments. This type of fracture results from backfiring of a motor while cranking. The wrist is in normal extension and in ulnar deflection when the violence is applied. The fragments become impacted and, with no interference, undergo gradual absorption.

(3) Fracture of the tuberosity. This type also results from backfiring, the wrist being in a state of forcible extension and in ulnar deflection. In this case the external radioscaphoid ligament undergoes sudden severe tension and tears off the tuberosity. This is the only extracapsular fracture of the carpal scaphoid.

A very rare simple transverse fracture of this bone occurring in forcible hyperflexion of the wrist has been described by Vialle [3] and Vallas. According to these investigators the usual tendency of the carpal bones to form two rows may be responsible for this forcible breaking of the scaphoid into separate distal and proximal fragments. It is probable that this fracture occurs in those rare instances where the scaphoid has two osseous centers and is but weakly united with calcified cartilage. (vide infra, Bipartite Scaph.)

Cases of scaphoid fractures are frequently complicated or complicate other fractures. In the great majority these occur in connection with fractures of the lower end of the radius. Dr. A. F. Tyler [8] advocates that every Colles' fracture should be examined for a scaphoid fracture as well. The Vialle, also known as Barton fracture, is a breaking off of the posterior lip of the lower end of the radius, produced by the impaction of the proximal portion of the scaphoid against its dorsal articular surface. At times the scaphoid itself escapes injury. In other instances fracture of the base of the metacarpal of the thumb or even of the second metacarpal bone occurred.

Course

A common observation in scaphoid fractures is that they tend to remain ununited. There is no tendency for the opposed surfaces of the fragments to cover up with cartilage or fibrous tissue, but they remain rough. Often a slight exuberance appears which causes severe pain when rubbing against the articular surface of the radius. Due to the fact that the scaphoid is comparatively free from attachments and that the majority of the fractures are intracapsular there is but very little displacement, so that displacement cannot be considered as a cause of non-union. John B. Murphy attributes this failure of union to a damaged blood supply, which even in the unbroken bone is not rich. Codman and Chase [4] believe that union is hindered by the fact that the fragments are constantly bathed in synovia. "It is in the very nature of the synovial fluid to exert an inhibitory action on plastic processes," observes Todd. The constant irritation sets up in addition a chronic inflammatory condition which even increases the quantity as well as the viscidity of the fluid.

John B. Murphy observed that fractures of type three, fracture of the tuberosity, alone of all the others, tends to unite if proper fixation is applied. It is explained by the fact that the fragments are outside the capsule.

Preiser [13] observed a rarifying osteitis beginning in the fragments after a certain interval. Tissue sections revealed a tendency to cystic degeneration. Often a pseudoarthrosis develops which gives way on the least turn or twist.

Symptoms and Physical Signs

Cases of fracture of the carpal scaphoid present themselves either recently after the injury, or, more frequently, from several months to one to two years after the initial injury, with the usual complaint that the wrist is not as good as it was, or that it hurts, or that it is weak, and that it somehow interferes with the wage earning capacity. In the old cases there is a history of an injury to the wrist which was regarded and treated as a sprain. In some cases there was some accompanying fracture, usually a Colles', which was treated while the scaphoid fracture was not recognized and was neglected.

There is a great deal of pain associated with any attempted movements of the wrist, especially those involving pushing with the extended hand or twisting. The patient is unable to turn door-knobs, must be very cautious in writing, and cannot participate in any games involving the use of the wrist. Often a sudden twinge of pain will cause the mechanic to drop his tools. All active and passive motions of the wrist are limited, particularly extension.

Attempts to continue passive motion beyond a certain limit will result in a muscle spasm similar to that in tuberculous disease. Even after many years while the pain is of lessened intensity it is sufficiently troublesome to interfere with the patient's work.

The first sign, as a rule, is swelling; it appears almost instantly after the injury. It is very characteristically marked in the region of the anatomical "snuff box." In the recent cases it is of greater degree and more extensive, but even then it tends to be limited to the radial side, never surrounds the whole wrist, and never obliterates the folds of the wrist. In the old ununited fracture there is still some swelling which is even more definitely limited to the "snuff box" region. A comparison with the uninjured side rarely fails to bring this swelling to the notice of the examiner.

Palpation will elicit severe tenderness localized exactly over the scaphoid, that is, in the anatomical "snuff box" when the wrist is in ulnar deflection. The exact localizing of the tenderness helps to differentiate this fracture from other fractures above or below the scaphoid.

Another reliable sign is the one known as the Vaughan [6] knuckle percussion test, which is carried out as follows: The metacarpophalangeal joints of the affected hand are flexed, and the head of each metacarpal bone is tapped smartly with an ordinary rubber percussion hammer. The presence of a fracture of the scaphoid will be manifested by severe pain only when the head of the second metacarpal is struck, and absent when any other is tapped, while lesions of the semilunar will give pain when the third metacarpal is struck. The anatomical relations of these bones easily explain the phenomena of the test.

Hofliger [7] found shortening of from five-tenths to one and five-tenths cm. in the measurement from the radial styloid to the end of the second metacarpal bone, but Todd emphatically states that in all cases he found the measurements in both sides exactly the same. John B. Murphy found shortening in only fractures of the second type, fractures with impaction.

Ecchymosis was never observed, because all the bleeding, which is rather small in quantity, remains within the capsule and does not reach under the skin.

Crepitus is as a rule absent on account of the little motion allowed the fragments.

Todd never found any local wasting associated with even the most long-standing of his cases, while Murphy claims wasting as one of the usual sequelae in the long-standing untreated cases.

X-Ray Diagnosis of Scaphoid Fractures

Owing to the peculiar shape and position of the carpal scaphoid the x-ray shadow is entirely apt to be deceptive, and without a proper technique it is very easy to overlook a fracture or to diagnose one where none exists. The bone may roughly be considered to consist of two thickened end-portions united by a third middle portion, known as the neck or waist. It is placed obliquely in the dorso-palmar direction so that it makes an angle of about forty-five degrees with the long axis of the forearm. Adduction of the hand, that is, the hand turned toward the ulna, diminishes the obliquity and both ends are in about the same plane, more or less parallel to the palm, while abduction increases the obliquity and makes the bone almost vertical to the plane of the palm. With the palm down on a flat plate in the abducted position the shadow of one thickened end will overlap that of the other, and will give the appearance of two separate pieces. Often the overlapping will cause the appearance of a notch, which will even further mislead to a wrong diagnosis of fracture. Then the appearance of the thin shadow of the neck between the more prominent ridges may also give the impression of a fracture.

Codman and Chase, therefore, lay down a precise standard technique. According to them both hands should be placed side by side, palms down, the hands should be as much ulnar deflected as possible, the tube placed in the mid-line and should reach over to the knuckles. They advise the taking of radiograms in different positions and angles, to determine the exact direction of the plane of fracture.

Todd advocates in doubtful cases the use of the fluoroscope for the reason that where the plane of the fracture is not at right angles to the surface of the plate and to the incidental rays, the rays will not pass along the plane of the space between the fragments and the presence of a fracture will not be recognized. But when the hand is slowly turned under the screen from the fully supinated to the fully pronated position there must be, at some stage, a moment when the rays will pass along the plane of the fracture space and appear as a bright band of light between the two shadows of the fragments. This precaution should be taken, particularly because of the fact that there is very little displacement in this fracture.

Tyler advocates the use of stereoscopic views in all cases of wrist injuries. He finds fractures in the stereoscopic view which were missed otherwise. Todd especially advises the use of stereoscopic views in cases where the fracture of the scaphoid is merely a part of the complicated injury of the carpus.

Variation of the Scaphoid Bone

The possibility of some variations in the scaphoid bone, that some scaphoids normally consist of two separate portions, or even of three, must be taken into consideration in the interpretation of radiograms. Pfitzner [9] in his study of the comparative anatomy of the carpus, found that some scaphoids consist normally of two or three parts. The bipartite consists of radial and ulnar bones, the tripartite has radial, ulnar, and central bones. Pfitzner also advances that even the normal one-bone scaphoid has two or three centers of ossification, which later in life become united by intervening cartilage, and when the cartilage fails to unite, there results the rare bipartite or the still rarer tripartite scaphoid. He investigated one thousand, four hundred and fifty-six wrists and found nine (seven left, two right) completely bipartite, and twenty-nine (fifteen left, fourteen right) partially cleft scaphoids. This observation has been confirmed by a number of independent observers. Gruber [10] found four bipartite and one tripartite scaphoid among three thousand wrists dissected. Von Wyss [11] saw in cretins two centers of ossification in the scaphoids of both sides. Woolf [12] cites a case of bipartite

scaphoid, bilateral, discovered accidentally with no history of injury, and no disabling symptoms in normally functioning wrists. But Codman and Chase state that in looking over one thousand and forty radiograms of wrists not one divided scaphoid was found without a history of injury. Todd admits that partition of the scaphoid does sometimes occur as a developmental reversion. Thomas Dwight [14] maintains that the normal one-bone scaphoid is very rarely fractured, and that most fractures of the scaphoid occur when violence is applied on a bone composed of two pieces united only by cartilage.

Diagnosis

In many cases the diagnosis can be made by the history and clinical findings alone, but a radiogram and fluoroscopy of proper technique are decisive. Clinically a suspected fracture of the scaphoid must be differentiated from the following lesions:

(1) Simple fracture or crack of the lower end of the radius. This fracture is particularly apt to cause confusion because, as Codman points out, such a fracture or crack on the dorsal lower end of the radius is likely to rupture the common bursa or sheath of the neighboring tendons, which fills with blood and appears as a triangular fluctuating swelling over the site of the scaphoid. Careful palpation, however, will show the maximum tenderness in the lower end of the radius and not the anatomical "snuff box."

(2) The question of various forms of arthritis may arise in long-standing cases. But a careful history, consideration of various etiological factors, a careful attention to physical signs, and ultimately a radiogram, will definitely differentiate the condition.

(3) Tenosynovitis or inflammatory carpal bursitis, can usually be eliminated by a history of limited use rather than over-use, by different distribution of tenderness and absence of characteristic crepitus of tenosynovitis.

(4) True "sprain" of the wrist or traumatic tenosynovitis, presents greater and much more diffuse swelling. But it is the opinion of most surgeons that true "sprain" of the wrist is extremely rare.

Summary

(1) "Sprains" of wrist which do not promptly recover are often fractures or dislocations of carpal bones. A very frequent injury is the fracture of the carpal scaphoid and it complicates fractures of the lower end of the radius.

(2) Colles' fractures, which do not respond to the proper treatment, should be examined for the presence of a scaphoid fracture.

(3) Simple fractures of the scaphoid give a definite clinical picture, viz., a characteristic history, definite symptoms and physical findings.

(4) Only radiograms made with a proper technique are reliable and ultimate. The fluoroscope should be employed in addition in doubtful cases.

(5) In interpretation of radiograms of the wrist the possibility of a bipartite or even a tripartite scaphoid should be taken into consideration.

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EDITORIAL

The JOURNAL OF RADIOLOGY

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Scientific Research—Or the Social Whirlwind

SCIENTIFIC research is now recognized almost universally as a condition prerequisite to intelligent planning and the sensible administration of practically every human relation save the one of individual health and happiness and their composite expression in the social welfare.

As demonstrating the greater respect scientists are accorded on the continent, attention is called to a somewhat aromatic nosegay offered by the editor of Muenchener Medizinische Wochenschrift, who

> "Insists that German medical men support the plea for *making English compulsory*"

in the preparatory schools of Germany on the ground that

> "Since scientific research in the United States has made such advances * * * and since American literature is on the point of taking the lead in medicine, a knowledge of English has become indispensible for the research worker."

As an aside, he adds:

> "English is the predominant language on four continents, and since German medical men may be long debarred from settling in French speaking countries, it must obviously be to their advantage to be familiar with English."

It would seem, then, that enough has been said to support the conclusion that medical science is being impressed every day with the social obligation to either assume a vigorous attitude concerning the value of scientific research as a method for discovering answers for numerous social ills, or suffer whatever penalty may be inflicted by those men and women who are conscious of the fact that they are the playthings of a social whirlwind, men and women who are beginning to recognize the scientific fact that a whirlwind, natural or social, can always be traced directly to a vacuum as the producing cause.

Very naturally, such a sweeping assertion will breed disputants. But one cannot attempt to visualize the present social tumult without realizing there is great need for some method which will sift the social jetsam through to a common purpose; and without realizing, too, that there is but one method sufficiently comprehensive, sufficiently elastic, and sufficiently deliberate in its search for the truth, to hold any promise of reducing the social chaos.

Speaking broadly, all scientific research must be organized deliberately; permanent records of its struggles and achievements must be established in order to insure the continuity of scientific labors; and scientific research itself must always be subjected to intelligent and constructive criticism.

A Scientific Obligation

The interest of the Radiologist in this broad statement of the problem is obvious when it is remembered:

1. That the correct value of medicine is exactly in proportion to its influence upon the social body as demonstrated in individual health, usefulness and happiness.
2. That the Radiologist is first a medical man, and as such in the practice of his science must draw constantly, intelligently and fully upon the sciences of pathology, biology, bacteriology, physiology, chemistry, physics, and electrical engineering.
3. That the present chaotic condition in the practical application of the science of Radiology is due, not to the failure of individual energy and sacrifice in scientific research, but entirely to the fact that no organized effort has been made by medical men interested in the subject to bring together in their proper relation the findings of individual labor, that is, the pathological, the physiological, the biological, the chemical, the bacteriological, the physical, and the electrical.

The Radiologist's Problems

With these thoughts in mind, it seems well at this particular juncture, to state specifically the most important problems before the Radiologist today, problems whose solution must be determined if the Radiologist is to function intelligently and effectively in the daily application of his science to the human family:

1. The biological action of radiation on normal and abnormal tissues.
2. The dosage required to obliterate each kind of cancer.
3. Action of massive treatment on the blood forming organs.
4. Cause of radiation sickness.
5. What quality of x-rays is best adapted for each kind of treatment.
6. Determination of the best kind of filter to produce desired rays.
7. Devising of methods for the prevention of delayed radiation reactions.
8. Standardization of dosage in accordance with known factors through the employment of a full-time physicist capable of testing machines in place and giving instructions to individual operators concerning biological reactions produced by different dosages.

Even a cursory examination of these problems will disclose that no other branch of medicine draws so much on all the other sciences as does Radiology. It would seem, also, to be an indisputable fact that the practicing Radiologist can never hope, as an individual working single-handed, to master all the other sciences to that point where he will be capable of making his own scientific explorations, establishing certain absolute factors, and applying them in the

solution of the problems he must inevitably meet as an intelligent and conscientious therapist. On the contrary, his only hope lies in his ability to establish contact with reputable workers in each of the sciences, and by collaboration with them, to bring to his clientele the ultimate in scientific knowledge as it is developed and established from day to day.

Commenting on the present social delirium, H. J. MacKinder, M. P., of London, former Director of London School of Economics and Finance, makes the statement that:

> "All specialization contains the seeds of death; the most daring army must, at times, wait for the supply columns to come up."

Without any thought of aspersion, that seems to be exactly the condition in which Radiology stands at the moment—it has grown to its present state of respectability and reputability as a diagnostic aid and therapeutic agent through the irrepressible energies and sacrificial labors of a comparatively few men, men like William Duane of Harvard University, Frances Carter Wood of the Crocker Institute of New York, C. R. Bardeen of Wisconsin University, Kennon Dunham of Cincinnati University, George Pfahler of Philadelphia, Preston M. Hickey of Detroit, A. S. Warthin of Ann Arbor, W. E. Petersen of Illinois, A. C. Ivy of Loyola University, W. D. Coolidge of Schenectady, N. Y., A. W. Erskine of Cedar Rapids, Ia., G. W. Stewart of Iowa University, etc., etc.—men who have labored unceasingly year in and year out in order that the science for which they hold a consuming passion might assume direction and purpose and dignity in the annals of medical attainment.

These men, perhaps, more than anybody else, appreciate the need for collaborated and co-ordinated effort among all research workers if the science of Radiology is ever to discharge its full obligation as a diagnostic aid and therapeutic agent.

Research Now in Progress

The following resume of original research work now in progress in the United States, with a subjoined statement showing the reputable medical universities, colleges of liberal arts and other scientific agencies which have already signified their willingness to co-operate with The Radiological Society in its research activities, will establish beyond question the value of, and opportunity for, co-ordinated and correlated scientific research in its relation to the science of Radiology:

1—Harvard University, Dr. William Duane, Professor of Bio-Physics.
"Research has had to do with high tension x-ray plants and x-ray spectra, which are produced by them under various conditions of voltage, current, filtration, distance and direction from tube. Are planning the study of character of the radiation at different points in a 'water phantom' and also of the amount of radiation, in terms of our method of measurement required to produce given effects in tissues (erythema dose, dose required to destroy various kinds of tumors, etc.) Also plan to study the changes produced in the blood picture due to this penetrating radiation."

2—Wisconsin University, Medical School, Dr. C. R. Bardeen, Dean.
"Cardiac radiology is being carried on at Madison especially from the physiological standpoint. The study of cardiac output demonstrated in animals and man, instantaneous pictures at two or more periods within a given heart cycle checked up by electrocardiograph tracings."

3—University of Illinois, College of Medicine, Dr. W. F. Peterson, Professor of Pathology and Bacteriology:
"Mobilization of enzymes following tissue irradiation. Possible activation of glands of internal secretion. Effect of irradiation on remote pathological lesions and acute diseases. Using dogs for experiment."

4—University of Michigan, College of Medicine, Dr. A. S. Warthin, Professor of Pathology:
"Pioneer research work in effects of x-rays on blood forming organs. Following study of changes in irradiated human tissue with special effort to discover any specific changes that may arise from such irradiation."

5—University of Iowa, College of Liberal Arts, Dr. G. W. Stewart, Professor of Physics:

1. Scattering of x-rays by light atoms.
2. Investigation of the absorption and emission spectra of the K and L series of tungsten.
3. An investigation of the tungsten x-ray emission and absorption spectrum with a vacuum spectroscope.
4. Spectra of gases excited by high frequency potentials.
5. A direct measurement of the principal reflective powers of crystals of selenium and tellurium.
6. A new method for the determination of the optical constants of metals in the form of small crystals, with results, especially in the ultra violet.
7. Magnetic rotary dispersion in colloidal solutions.
8. On the optical constants of certain crystals.
9. Thickness of thin films and the Hall effect therein.
10. An investigation into the behavior of various dielectries when carrying alternating currents.
11. Action of cylindrical coils carrying high frequency current.
12. Electric phenomena in gaseous discharge produced by high frequency potentials.
13. Mathematical investigation of the motions of electrons and ions under the action of various types of electric fields.
14. The theory of acoustic wave filters.
15. The phase change in acoustic wave filters.
16. Acoustic wave filters; extension of experimental filters to unequal and alternating sections.
17. The attenuation factor in a low-frequency-pass-acoustic filter.
18. The action of conical horns.

6—Loyola University, School of Medicine, Dr. A. C. Ivy:
"At present at work on 'Studies on the Effect of X-ray on Glandular Activity'."

7—University of Cincinnati, College of Liberal Arts, Dr. Louis T. More, Department of Physics:
"Thoroughly equipped to carry on research in the radiological discharge of electricity through gases both with apparatus and with men who have specialized in this field. At present engaged in research work in determination of crystalline structure of metals, x-rays in surgery and absorption of very short x-rays. Are offering a special course on theory and practice of x-ray discharge of electricity through gases. 'We have developed here

a course tending to train experts in this work, especially medical students, in our thoroughly equipped medical college, to become experts in x-ray work, and we are also offering special courses leading to the training of experts in these general subjects to those who are not in the medical college'."

8—Leland Stanford University, Liberal Arts and Sciences, Dr. L. Webster, Professor of Physics:
"Research work being carried on in Department of Roentgenology."
1. Development of modification of Hull type high tension rectifier.
2. Clinical studies in:
(a) Spinal arthritis.
(b) Pelvimetry.
(c) Orthodiagraphy of the heart."

9—University of Kansas, Liberal Arts and Sciences, Dr. F. E. Kester, Dean of Physics:
"Experimental equipment consists of Coolidge apparatus—interest centers on purely physical aspects of x-ray phenomena, crystallography, wave length, etc., rather than around therapeutic aspects."

10—University of California, College of Liberal Arts and Sciences, Dr. Elmer Dershem, Professor of Physics:
"Have recently completed the construction of a very high grade x-ray ionization spectrometer with the auxiliary apparatus for maintaining exact control of the penetration and intensity of the x-rays emitted by the x-ray tube. This apparatus has been used in making precision measurements of mass absorption coefficients of various substances for x-rays of different wave lengths. This work is not yet completed. In addition, the department is constructing a couple of x-ray spectrographs. One a vacuum spectograph for soft x-rays and another for use with the more penetrating rays. The purpose of these instruments is to enable us to measure the wave lengths of the characteristic lines of x-ray spectra with more precision than has been done by others heretofore, and we also hope they will enable us to discover lines not previously found. In addition, Dr. Dershem and Dr. Paul Kirkpatrick are endeavoring to secure a measure of the amount of polarization produced in a beam of x-rays by reflection from a crystal."

11—Washington University, College of Liberal Arts, Dr. Arthur Compton, Professor of Physics:
"Principal interests in connection with the measurements of secondary x-rays lie:
1. Examining the nature of secondary x-rays to see what part of it is scattered and what part is fluorescent in character.
2. On intensive investigation of the scattering of x-rays with the object in view of determining the arrangement of the electrons in atoms and the size of the electron and certain minor problems which naturally accompany these investigations."

12—Rush Medical College, Dr. John M. Dodson, Dean, Dr. Cassie B. Rose, Instructor in Roentgenology:
"Our particular field here is the correlation of x-ray and clinical and pathological findings inasmuch as a great deal of the material of the hospital (Presbyterian) and College is suitable and available for this work."

13—Dr. Kennon Dunham, Cincinnati Tuberculosis Sanitarium, conducted under the direction of the Cincinnati University:
"We are carrying on at present the following work: (1) The determination of the normal chest of the child between 6 and 10, from a physical examination and x-ray plates; (2) Studies of the pathology of x-ray densities within the lung, and (3) Absorption of tuberculous exudates."

14—Dr. George Pfahler of Philadelphia, in co-operation with Drs. Kolmer, Schamberg and Case:
"Studies of the clinical values of radiation in mouse cancer."

15—Dr. A. W. Erskine of Cedar Rapids, Iowa, in conjunction with Coe College and St. Luke's Hospital:
"Studies in pure physics concerning technique, apparatus, protection, etc.

16—Dr. C. A. Donaldson, Minneapolis, Minn.:
"Keeping blood record daily during treatment, chemistry before and after. Has partly completed experimental films, showing various voltages through 1, 2, 3 and 4¼ copper, using a fresh meat bone with voltages from 50 to 200,000 at 50 cm."

17—Dr. Clarence F. Ball, Rutland, Vermont:
"Uncompleted studies in the metabolism of amino-acids in patients suffering with cancer, and the change which x-ray brings about in the difference between normal metabolism and abnormal metabolism in the patient."

18—Dr. M. J. Sittenfield, New York City, working in Department of Pathology, Columbia University:
"For the past twelve years conducting cancer studies for purpose of determining tumor growth after injection of radiated tumor emulsion and for past five years experimenting with photodynamic substances in combination with radiations of short wave lengths. Preliminary report almost completed."

19—Columbia University, Crocker Cancer Institute, Dr. Francis Carter Wood, Director:
"In reply to your letter of February 25th, regarding the establishment of a Research Department of The Radiological Society of North America, I beg to say, that the Institute of Cancer Research is carrying on a large amount of experimental research on the physics underlying the treatment of cancer by x-ray and radium, such as the determination of the killing dose of tumors, the effect of different filters, the study of scattering effects, absorption in the tissues, etc., with an idea of ultimately being able to discover a method by which x-ray dosage can be accurately measured for clinical use."

Scientific Agencies Listed

Listed below are those Medical Universities, Colleges of Liberal Arts and Sciences, and other scientific agencies which have to date signified their willingness to co-operate with The Radiological Society:

Medical Universities

Boston University
California University
Cincinnati University
Columbia University, Crocker Cancer Institute
Cornell University
Creighton University
Illinois University
Indiana University
Kansas University
Leland Stanford University
Loyola University, Chicago
Marquette School of Medicine

Dartmouth College
Detroit College of Medicine
George Washington University
Hahnemann Medical College
Harvard University
Howard University
Michigan University
Missouri University
Ohio State University
Oregon University
Rush Medical College
Vanderbilt University
Washington University
Wisconsin University

COLLEGES OF LIBERAL ARTS

Boston University
California University
Cincinnati University
Coe College
Emory University
George Washington University
Iowa State University
Johns Hopkins University
Kansas University
Leland Stanford University
Louisville University
Michigan University
Minnesota University
North Dakota University
Northwestern University
Ohio State University
St. Louis University
Utah University
Washington University
Wisconsin University
Yale University (Sloane Lab.)

SCIENTIFIC AGENCIES

United States Bureau of Standards
Medical Division National Research Council
National Dental Association
St. Lukes Hospital, Cedar Rapids, Iowa
Hahnemann Hospital, Philadelphia
Central Illinois Radiological Society
Detroit Research Club
Milwaukee Research Society
Cincinnati Tuberculosis Hospital

PROFFERED ASSISTANCE

Collis P. Huntington Memorial Hospital, Harvard Medical School, Boston.—February 28, 1922.

"Let me congratulate you and The Radiological Society upon the interesting and exceedingly important activity which you are planning to carry through.

"I am sending you the following notes and would be glad to give more details if you desire it.

"1. We are now carrying on researches on high tension x-ray plants and on the x-ray spectra which are produced by them under various conditions of voltage, current, filtration, distance and direction from tube, etc. These researches are designed to furnish data of a fundamental character for the deep x-ray therapy. So far, these have been carried on in the Physical Laboratory of Harvard University. We are now moving into a new laboratory, however, built for the purpose by the Cancer Commission of Harvard University.

"Among other things, we have developed a new method of measuring both the intensity and the penetration factors of an x-ray beam. The intensity factor is measured by means of an ionization chamber, and, as an estimate of the penetration factor, we take the average or 'effective' wave-length of the beam and determine it quickly by estimating the thickness of aluminum that absorbs the same fraction of the radiation that a given thickness of copper absorbs. From this thickness of aluminum, we read off the 'effective' wave-length by means of a curve.

"2. As soon as the x-ray plant has been installed in the new building we expect to begin a systematic study of the character of the radiation at different points in a "water phantom," and also of the amount of radiation, in terms of our method of measurement, required to produce given effects in tissues (erythema dose, dose required to destroy various kinds of tumors, etc.) We are also planning to make studies of the changes produced in the blood picture due to this penetrating radiation.

"3. The apparatus and funds for carrying on the work come partly from the Cancer Commission and partly from the Department of Physics of Harvard University. At present I have $2,400 for salaries of assistants and about $1,500 for other expenses with occasional grants for special purposes. I divide the $2,400 into three parts and appoint two part-time students as assistants and one full-time young man who does the routine work required. There is also a roentgenologist at $2,500 a year, who will supervise actual treatment, but he will probably have very little time for research work. These funds and personnel are grossly inadequate for carrying on the work as rapidly and effectively as I would like to do, but one has to do the best he can with the means at his disposal.

"4. I find that the most pressing financial need is for suitable assistants to carry on the work. It is not difficult to get money for buildings, especially in connection with the cancer problem, but the funds required to run the plant, especially to pay the necessary labor, both intellectual and manual, are not always forthcoming. I feel that I ought to have here at least one full-time man on a salary of $2,500 or $3,000 a year, who would be capable of carrying out suggestions without my personal supervision all of the time. The above mentioned salary is about what the Rockefeller Research Fellows in Physics and Chemistry earn. I have frequently urged the necessity of funds for this purpose on the National Research Council. This seems to be the greatest difference between the research work as carried on in America and in Europe.

"Anything that I can do to help out your committee in this important activity will be done with great pleasure."

Yours sincerely,
(Signed)—WILLIAM DUANE.

Columbia University, in the City of New York, Institute of Cancer Research.

"In reply to your letter of February 25th, regarding the establishment of a Research Department of The Radiological Society of North America, I beg to say that the Institute of Cancer Research is carrying on a large amount of experimental research on the physics underlying the treatment of cancer by x-ray and radium, such as the determination of the killing dose of tumors, the effect of different filters, the study of scattering effects, absorption in the tissues, etc., with an idea of ultimately being able to discover a method by which x-ray dosage can be accurately measured for clinical use.

"I shall be very glad to co-operate in any way with the Research Committee of the Radiological Society, and have an ample staff for the carrying on, at the request of the committee, of any type of work which seems worth while, provided that any excessive expenses can be met. Our own funds are wholly involved in the programme of experimental work already laid out."

Very sincerely yours,
(Signed)—FRANCIS CARTER WOOD, Director.

March 27th, 1922.

"I most heartily approve of this step to further research by The Radiological Society and we may heartily approve of these efforts of the chairman. Be assured of my most hearty co-operation. Not only can this effort help research, but it can help to place the x-ray work of the United States upon a footing with the best research in our country.

"There is no field of medicine which presents so many possibilities in research work. Let me give you an example as to how your efforts could help in Cincinnati. I am mak-

ing this suggestion as a concrete example of how a little money, combined with the approval of our society, can be made to go a very long way. I am not asking that you enter into this research unless it appeals to your committee. I am using my present needs as an example to show you how I think the greatest good can be obtained with the least money.

"I am sure that great benefit can be obtained by treating selected tuberculosis patients with the x-ray. Much experimental work has been done upon animals and more is to be accomplished.

"I lack two things at the Cincinnati Tuberculosis Sanatorium—first, high tension equipment; but this will be of no avail unless I can secure the services of an adequate technician who can devote the necessary time to blood chemistry, metabolism and differential counts.

"Suppose, in the judgment of your committee, such a research was considered worthy of real scientific effort, and that you could write a letter addressed to the President of our University stating that you would be able to put a certain sum of money ($1,200) yearly to secure the services of a trained technician provided that board and room would be furnished for a period not to exceed two years. If such a letter could be written I am sure that private funds would soon furnish the equipment, and the University and the Tuberculosis Sanatorium would quickly arrange the necessary accommodations and the work could be started within sixty days.

"Thus, we would have, free of charge, the services of the Pathological Department, the Medical Department, the use of 250 patients from whom to select suitable cases, a complete animal house with the necessary care of the animals, all for the cost of the technician.

"The capital for the machine would be easier to raise by private subscription than the salary of the technician, and the routine work of our hospital is so heavy that the two technicians whom we are allowed could not possibly take on this added labor.

"The experimental work which Dr. Rogers and I have already done indicates that this offers great possibilities in the treatment of selected cases of tuberculosis, but in any case where there is much caseation x-ray treatments seem to be detrimental.

"To do this work adequately a great number of tests must be made for a great variety of treatments, because we do not know at present any of the factors of the x-ray dose, nor the frequency with which they should be repeated. We have pretty well determined that the reaction upon the mononuclear cells of the blood is the yard-stick, which must be used to determine this dosage. Dr. Samuel McIntosh of the Physics Department of the University, who worked for many years with Rutherford, has agreed to help me with the physics if we are ever able to undertake this experiment.

"In answer to the questions of your former letter, I would say:

"First—A. We are carrying on at present the following work: The determination of the normal chest of the child between 6 and 10, from a physical examination and the x-ray plates.

"B. We are continuing to study the pathology of x-ray densities within the lung.

"C. We are finding some very interesting notes upon the absorption of tuberculous exudates.

"In answer to question (2) you have my dream for the future.

"In answer to question (3) we have the personnel and the funds for everything except the equipment of a large machine, which I know can be obtained, and the funds necessary for the technician. I am sure that this would take less than $1,200.

"Question (4): I can only suggest that in my judgment the best work can be obtained with the least money, by aiding research under way, than by trying to create new research laboratories.

"Be assured of my hearty co-operation in any way within my power. In my judgment, this is one of the biggest things that any organization can undertake.

"With much esteem, I remain,"

Cordially yours,
(Signed)—KENNON DUNHAM.

The University of Wisconsin, Madison—Jan. 26th, 1922.

"1. As a rule I think more can be done by aiding research already under way than by outlining problems and trying to find some one to carry them out. Therefore, in answer to your first question I should say that the best thing would be to collect data not only on what work is now being carried out, but on estimates from the workers in various fields as to what funds they are urgently in need of in order to carry the work out effectively. The Central Committee should then determine to which of these projects such funds as are available might be devoted. This also answers your second question.

"3. If the department has a list of the scientific work in radiology being carried on and a list of financial needs for furthering this work, the central committee can do a great deal in furthering those lines of investigation which appear most promising, provided they have funds at hand.

"The work in radiology being most actively carried on in this university at the present time is in the field of cardiac radiology, especially from the physiological standpoint. The study of cardiac output, as demonstrated in animals and man, instantaneous pictures at two or more periods within a given heart cycle checked up by electro cardiograph tracings, are similar problems.

"4. It seems to me highly probable that there are numerous lines in radiology in which combined work could be carried out to advantage. A central committee would be very helpful in encouraging this. This would be especially true of statistical data, and any investigator desiring more statistical data than he can readily command should communicate with the central committee. The central committee would in turn communicate with those workers who the committee feels would be helpful in such co-operative work.

"I shall certainly be most happy to aid in any way I can the work of the committee, which I feel is highly important. I am more and more impressed with the splendid vigor of The Radiological Society.

"With best regards,"

Sincerely yours,
(Signed)—C. R. BARDEEN.

University of Cincinnati—March 23, 1922.

"I have been very much interested in your proposition from the beginning, but have simply postponed getting down to writing out the details.

"The Department of Physics of the University of Cincinnati and I personally are quite ready to co-operate with your society in promoting its purposes. I am certain that we can do our share of the work, as we have for many years devoted much time to this subject and have published many articles dealing with it. We are thoroughly equipped to carry on research in the radiological discharge of electricity through gases, both with apparatus and with men who have specialized in this field. On the purely scientific side we are at present engaged in research work in the de-

termination of crystalline structures of metals, x-rays in surgery, and the absorption of very short x-rays. We offer a special course on the theory and practice of x-ray discharge of electricity through gases.

"We have developed here a course tending to train experts in this work, especially medical students, in our thoroughly equipped Medical College, to become experts in x-ray work, and we are, also, offering special courses, leading to the training of experts in these general subjects, to those who are not in the Medical College.

"Thus, you see, we are in a position to take up any problems that you may think it wise to suggest to us and to enter into the plans of your society."

Yours very truly,
(Signed)—LOUIS T. MORE.

Loyola University School of Medicine, 706 South Lincoln St., Chicago—March 22, 1922.

"We are heartily in favor of your plan and believe that it will do more to stimulate research in radiology than any other plan that might be devised by The Radiological Society or any other organization. It is an excellent idea.

"We are intensely interested in radiological research from the physiological standpoint. The problem that we are working on at the present time is 'Studies on the Effect of X-Rays on Glandular Activity.' We have practically completed the work on the submaxillary gland and are now working on the gastric glands. We will next study the testis.

"As the above problem is very inclusive, no other problem will be undertaken for some time.

"The personnel working on the above problem at present consists of myself, Dr. Orndoff and two student assistants.

"Our apparatus is limited in amount and any deficiency in apparatus is overcome by a loan of apparatus from the supply of Dr. Orndoff.

"We have no funds at our disposal for our work. The work is being done because of our interest in it. The student assistants at present receive no pecuniary compensation for their endeavors.

"I am of the opinion that it would be well for the committee or a permanent secretary to distribute the money that the society has for the purpose of research in the form of grants. Before making such a grant the conditions in each laboratory should be investigated by the committee or a permanent secretary. Such a plan would place funds not only where they are needed, but also where they will yield the greatest returns. Such a plan of grants might be supplemented by the condition that the grant will be increased provided the laboratory or the university concerned would add a certain sum to the grant.

"Asking your pardon for the trouble caused you by my delay in answering your previous communication, and wishing the greatest success to attend you in this wonderful and far-reaching program, I am,"

Yours truly,
(Signed)—A. C. IVY.

University of Michigan, Ann Arbor—March 29, 1922.

"In reply to your letters presenting the plans which The Radiological Society are fostering for collaboration in research, I should like to say that this Department looks with favor upon any such undertaking.

"We are just establishing an x-ray outfit for research purposes, and have one graduate student doing work at the present time. Professor Lindsay, who will be in charge of the x-ray work of the Department is at present abroad and will not return until the beginning of the coming college year.

"Within a year the department will move into a new laboratory, and we expect at that time to have an equipment which will permit us to do very effective research in x-rays.

"I have believed for some time that one of the most promising fields for research lies between physics and the biological sciences, including medicine, and I should be glad to foster work in which the Department of Physics and Medicine would collaborate. Due to the fact that my own interests are in other fields and that our work in x-rays is only under way, I haven't definite suggestions to make other than the general ones which I have just stated.

"I shall appreciate it if you keep me informed of the progress which the society is making in this particular."

Very sincerely yours,
(Signed)—R. M. RANDALL.

University of Michigan, Ann Arbor—March 3, 1922.

"Replying to your letter of February 27th, I have always, personally, been interested in the effects of x-rays and radium upon the human tissues, and have always made it a point to study as thoroughly as possible any irradiated tissues that are sent into the laboratory for diagnosis.

"You may be aware of the pioneer work that I did in the effects of x-rays upon the blood forming organs. This was done independently of the work of Heineke, although his was published a few months earlier, while my paper was still in press. His paper, as well as mine, were considered epoch-making, and the literature on x-ray pathology since that time has largely been based upon those two papers, and very little that is new has been offered since then. I am sending you reprints of my earlier papers.

"At the London Congress of 1913 I was asked to give a resume of my work and this was largely copied in foreign journals. I feel, therefore, that my laboratory has some reason to be proud of what it has accomplished earlier in this work.

"If we could obtain proper help in the way of technical assistance, or otherwise, to relieve me of some of the great detail of work that hinders my research activities now, I should be extremely glad to go at these researches more intensively. I have no special funds, but have only the general outfit of my laboratory to be used for this purpose. At the present, the one line of research in this field that I am following with interest is the study of the changes in irradiated human tissue with special effort to discover any specific changes that may arise from such irradiation. This I consider a very important thing in the field of general diagnosis, as we are constantly asked if we can see any changes in tissues resulting from such treatment.

"I should like very much to continue this work in a more intensive way if the laboratory could receive some assistance that would enable it to do so. Doctor Rollin H. Stevens of Detroit, about two years ago, offered to co-operate with us and give the laboratory the funds for such work. At that time we could find no individual to carry on the type of work that he wanted, which was to check up the cases treated by him in Detroit, and we were unable, and would still be so, to make use of such a fund under such conditions. If the laboratory could be given outright a research fund and if the published researches made with the assistance of this fund could be published from the laboratory with the statement 'assisted by a grant from The Radiological Society,' just as we publish other research work under other grants, I should be very glad to have the laboratory co-operate with the society in this way.

"We receive a sufficient amount of material that has been irradiated to give us during a year enough material for such study. As I myself am personally interested in this work that I am now doing, I should assume personal direc-

tion of it, and my especial need would be funds sufficient to employ a special technical assistant to prepare the material for my study.

"I shall be very glad to give you further information, but this is probably sufficient to begin with, and will give you an idea of how the proposition appeals to me."

Sincerely yours,
(Signed)—A. S. WARTHIN.

Indiana University—March 9, 1922.

"Dr. Emerson, the Dean of the Indiana University, has referred your letters to me in regard to research along the science of Radiology.

"I am sorry to say that the department is just being established along practical lines and we are not in our new quarters and have not had the opportunity to put radiology to so high a standard. We do, however, hope to start some thing along this line before long. Our equipment is of the very best and the personnel consists of two well trained, well paid technicians and myself. Dr. Cole and Dr. Smith of our office also help me out in many ways and we are all working for the ideals which your plan intends.

I am sorry that I cannot give you anything more than this, but hope to before very long.

"With kindest regards, I am,"

Sincerely yours,
(Signed)—R. C. BEELER.

University of Illinois, College of Medicine, Chicago, Ills. March 6th, 1922.

"I am sure that we shall be very glad to co-operate with your committee in every way that you suggest, even if for the time being we will not need financial support. At the present time our laboratories are quite out of date, both in space and equipment, but as you may know, the University will within a year or two have a large building for research work and we shall then be in a position to carry out a number of experiments which so far we have not been able to do.

"(1) The problems that we have under way and in mind concern biological reactions brought about by irradiation. I do not think that we will ever take up physical or engineering problems here; the proper departments for work of that type are at Urbana and our connection is unfortunately not close. Our work has concerned the mobilization of enzymes following tissue irradiation, the possible activation of glands of internal secretion, the effect of irradiation on remote pathological lesions and acute diseases, etc. We are using dogs for the purpose, but are limited because of the crowded condition of the laboratory. Under the conditions the work can be carried on but very slowly and there will be no improvement until we get into our new building.

"(2) We have sufficient departmental funds at our disposal at present to carry on the work in its limited form. If it can later be expanded under favorable prospects we might ask some assistance in the way of salary for a half or full time research worker who could devote his entire time to the problems. Apparatus and other expense would be covered by the university funds. I believe this would give you a maximum return for the outlay and will approximate, I presume, the plan that you have in mind to aid the study of irradiation problems.

"Such a grant would not require more than about $1,200 to $1,500 per year for perhaps two years. At present we could not properly make use of such funds. In a few years, I believe, we would be in position to use them with profit.

"If at any time I can be of any service to you I shall be very happy to have you write me."

Very sincerely,
(Signed)—W. F. PETERSEN.

George Washington University, Medical School, 1335 H Street, N. W., Washington, D. C.—March 30, 1922.

"It seems to us that the idea of The Radiological Society of North America is an excellent one. We are not at present doing any special research work along radiological lines in this institution, but we hold ourselves in readiness to co-operate with any committee you may appoint and to undertake any work for which we are equipped. We are quite in accord with the principle you have stated that research work in the various institutions of the country should be coordinated and have some sort of general direction if that is possible. We will be glad to co-operate with you in your attempt to bring about this end."

Very truly yours,
(Signed)—W. C. BORDEN, Dean.

Department of Commerce, Bureau of Standards, Washington—December 20, 1921.

"(1) Referring to your letter of December 12th on the subject of a clearing house of information to connect members of your society and the various research institutions and research workers in the United States, we have long felt that real progress in the technique of using radiation of various kinds for therapeutic purposes was essentially dependent upon a better knowledge of the physical properties of the radiation used. If the committee which you propose to establish can secure better co-operation between your members who are engaged in the practical use of radium and x-rays or other radiation, and the research workers who have dealt with the quantitative study of such radiation, we believe it will be of very great value.

"(2) As you are probably aware, there has been so much demand for the measurement of radium preparations in connection with their sale that this bureau has been obliged to concentrate on this one kind of service practically all of the resources which it could devote to the work. Consequently we have produced very little original information on the properties of radioactive materials or of x-rays. For several years we have been trying to obtain a small special fund to begin some research in this field, but up to the present time these efforts have been in vain. There is now a fair prospect that we may obtain such a fund for the fiscal year beginning next July. If this is granted we hope to be of greater service to those members of your profession who are interested in radiological work.

"(3) Under present conditions we would not be able to contribute much which would be of interest to your journal. Furthermore, we realize that to be really useful to members of your profession, the material would need to be prepared by some one who is familiar with their problems and could put the information in suitable form for your readers. Consequently, as a specific reply to your inquiry, it seems best to say that this bureau will be very glad to co-operate as effectively as possible with your proposed committee and that we shall be glad to receive from you any suggestions you care to offer as to the best procedure for making such co-operation effective."

Respectfully,
(Signed)—S. W. STRATTON, Director.

National Research Council, 1201 Sixteenth St., Washington, D. C.—Kalamazoo, Mich., March 10, 1922.

"In accordance with the request of the chairman of the Medical Section of the National Research Council, I

named an x-ray committee. This committee was to be ready to take up any line of research which was desired because of military conditions especially, but also any other conditions in times of peace that might be brought up by the Council. There has never been any demand made upon this committee and the committee has never met. I endeavored, however, to forward the general purposes of the Research Council and made a motion in an executive meeting of the American Roentgen Ray Society to give $1,000 as a prize for the best piece of research in the field of x-ray or radium. I also talked up the matter of a special lecture to be given at each meeting and to be named after some distinguished member of the society who had passed away. As you know, Dr. Case, during his presidency, inaugurated the Caldwell lecture.

"I was, therefore, very greatly interested in your efforts toward founding a Research Bureau. I trust that you can put this through. I would be very glad if you would use your position as a member of the x-ray committee of the Medical Section of the National Research Council, in pushing this matter."

Sincerely and cordially yours,
(Signed)—A. W. CRANE.

National Dental Association, Minneapolis, Minn.—March 8, 1922.

"Certainly, the National Dental Association and its members ought to be willing to co-operate with any and every ethical society. Research work is not for an age, but for all time, and not for an individual, but for humanity.

"The plans of the National Dental Association Research Commission are in the hands of the president and secretary of the commission. Doctor F. O. Hetrick is president and he resides in Ottawa, Kansas. Doctor R. H. Volland can be addressed at the Iowa College of Dentistry, Iowa City, Iowa.

"I am so extremely busy with the work of the whole association as its president that I have not been giving detailed attention to the work of the commission. At the present moment, the particular researches under my care are financed and we have everything necessary with which to carry them on furnished by the University of Minnesota. Thousands and thousands of dollars of good research apparatus of all types is there. I put in a budget from year to year to take care of the necessary pay of the men who carry on the work. I would think the way to co-operate with the research workers of the National Dental Association would be direct with the Research Commission. Any funds you might be able to spare for that purpose should, I think, go into the hands of the treasurer of the commission, to be apportioned by the commission itself, which consists of twenty odd men who meet yearly at the time of the meeting of the National, reporting to the National the researches under way during the past year and authorizing new researches where they see the need exists.

"Thank you for your very important letter and command my energy at any time you see fit."

Very sincerely yours,
(Signed)—THOMAS B. HARTZELL.

Some Pertinent Suggestions

Harvard Medical School, Department of Physiology.

"Some time I wish that a careful worker would go over in detail the work which I did on the rate of discharge of food from the stomach and see to what degree it is true also of human cases, and in case there is some difference between the rate of discharge of carbohydrates, fats, and proteins in man and those that I observed in the lower animals, I wish that an inquiry could be made as to how the difference can be accounted for."

(Signed)—W. B. CANNON.

Baltimore, Md.

"Research of any kind costs money. Majority of men in practice are hampered in the correct study of their own observation by lack of funds. Majority of universities are in the same condition. Therefore, if your society wishes to encourage research for the benefit of its members, they must create a research fund. Small contributions from many members will be helpful to the few who are in position to make the research for the benefit of all. Codman's scheme of the registration of bone sarcoma is a good example. The American College of Surgeons have given him $1,500 to continue the work.

"I would suggest that The Radiological Society request its members to register every case of malignant disease treated by x-ray or radium, with or without operation, in which the patient is well five years since the beginning of treatment; then, have the data submitted to a committee to verify the diagnosis and decide whether it is correct."

(Signed)—J. C. BLOODGOOD.

Detroit Medical College

"Expressing my personal opinion in the matter, I feel with others that the society should attempt the problems which can be solved only by the closest expert study. There are, as I see it, two fields, that of clinical research, and that in the domain of physics. The former is the particular field of the medically trained man; the latter largely that of the physicist. I would not attempt to speak for the second class. It seems to me that we are largely in need of well written text books. This means a thorough sifting of the papers which have appeared from time to time in the various radiological journals within the last five years.

"It seems to me also that the time is ripe to attempt to crystallize the opinions of the profession in the matter of radium and x-ray therapy."

(Signed)—J. H. DEMPSTER.

University of Utah

"The present day layman is in a way aware of the beneficent results of scientific investigation, but he is too much inclined to give undue credit to the spectacular and not enough to painstaking study. The surgeon is rated higher than the careful scientific diagnostician. The x-ray photographer is too often paid at a rate far in excess of the physician who diagnoses the cases. So many men who sign themselves roentgenologists are nothing more than x-ray photographers.

"The writer has made hundreds of x-ray exposures and believes the skill and knowledge necessary to do this work is really less than that required to make a good photograph. In any case the mere taking of x-ray pictures is such a simple matter that the ridiculous charge of $50.00 for a chest or pelvis seems an exorbitant extortion when perhaps the physician is getting ten dollars for making the diagnosis.

"This difference between the spectacular and real scientific analysis is a matter which I believe the Radiological Society proposes to set before the public. I hope some distinction can be made between the man who operates the switches and the student of the x-ray plates."

(Signed)—ORIN TUGMAN, Professor of Physics.

The Ohio State University

"Taking up more specifically the points mentioned in your letter upon which you welcome suggestion, I believe that you must maintain a large publicity bureau to educate

the public concerning the truth of radiation therapy. Such a bureau must be intellectually honest, not afraid to say that radiation fails in cases where it manifestly does fail, but also not afraid to combat such distortion as that referred to in Dr. Williams address as given by the Associated Press.

"As I see it, what we need is not so much more agencies or institutes of any kind, but a correlation and co-operation between the existing agencies. Physicists and radiologists have got to work together more and means have got to be found to enable them to do that. Radiologists working above 100,000 volts have certainly got to have more understanding than in the past upon the physical and electrcial engineering problems involved in the proper control and measurement of the voltage, x-ray dosage, etc.

"I am just installing an x-ray power plant at this laboratory that will enable me to obtain 50,000, 100,000 or 200,000 volts. When it is installed it will be possible for our pathologist, Dr. Ernest Scott, to submit rats and guinea pigs having cancer to x-ray radiation, thus experimenting along lines similar to what Dr. Wood of the Crocker Cancer Research Laboratory is doing. Naturally, however, I intend to do some purely physical research with this apparatus, one of the problems I am interested in being an engineering problem, the x-ray analysis of various alloy steels.

"What organization ideas I have run along this line. Much of our progress of the future in science has got to be done by groups of individuals rather than by single individuals. In many cases how much more can be done by chemist, physicist, bacteriologist, pathologist, and radiologist working together than by such individuals working alone. Can't your society develop a means of bringing about the proper liaison between such scientists?"

(Signed)—F. C. BLAKE, Dept. of Physics.

University of Oregon

"I think there is a great field for study in the standardization of the therapeutic use of radium and roentgen light, which, as far as I am able to see, is still in a very formative stage."

(Signed)—RICHARD B. DILLEHUNT,
Dean, Medical School.

Yale University, Sloane Laboratory

"I should like to suggest that an appropriate study which your society could push to advantage is an investigation of what is the relative value of the various wave lengths of light and also of x-rays in the killing of tubercle bacilli. In the same connection, a study should be made of the rate at which the human body absorbs these various radiations so that it would be possible to find what is the most effective wave length for use at any depth in the body.

"That being once determined, it would be up to the physicist to devise sources of light which would be most useful for this purpose, and it may well prove that sunlight is not the most effective agent to be used for the cure of tuberculosis."

(Signed)—JOHN ZELENY.

St. Louis University

"I am scarcely in a position to offer any suggestions which are not old or well known to you already. If there is one feature in x-ray work that needs attention, it is the development of some means of determining with safety and accuracy the strength of exposure which is proper in the large variety of cases for which x-rays are used. An x-ray machine in the hands of an inexperienced doctor or of an experienced one under extraordinary circumstances, is a danger truly to be feared. But this is an old idea, and one that you are equally convinced needs solution."

(Signed)—HUGO F. SLOCTEMYER,
Department of Physics.

University of California

"In this department we give courses on the production, characteristics and nature of x-rays and radium, but have not taken up any of the aspects of the subject which would be of the most value to the practitioner. In our medical school there are specialists in the use of x-rays and radium, but they are apparently not much interested in those aspects of the subject which interest us most. As in the case of all border subjects, it is difficult to find men who have interests sufficiently broad to see all sides of the subject. I think the most immediate problem before us is the institution of courses for the training of such men, which would have to be differentiated both from that of the specialist in physics and that of those who intend to practice radiology as an art. It is very important that this subject should have a solid scientific foundation."

(Signed)—E. P. LEWIS,
Department of Physics.

The University of North Dakota

"Our department at present is doing no research work connected with the work of the society which you represent. Personally, I feel that one line which might well be undertaken by a research department of your society would be to act as a clearing house for information, developments and research problems in your field. For example, I think it would be well worth while if at least once per year the Physics Departments of our institutions could receive a summary of the worth while developments in radiology and also a list of the research problems, the solutions of which are needed. I feel that our college departments, as for example, physics, are insufficiently in contact with the fields of application. If the department which your society is contemplating, could help to make this contact close, I believe it would be of benefit to all."

(Signed)—KARL H. FUSSLER,
Department of Physics.

The Johns Hopkins Hospital

"In reply to your letter of January 21st regarding the research department of the Radiological Society, written to me as Dean of the Medical Department of the Vanderbilt University, I wish to say that I have not as yet entered upon my duties at Vanderbilt University Medical School, nor have I undertaken any extensive planning for the x-ray work that will be pursued in the new school.

"From the general point of view of an internist, I would like to say that I feel that the most important line of research that can be undertaken in radiology is that regarding the underlying principles upon which therapeutic action of rays depends. It would be of great value to know, for instance, what the therapeutic rays have in common, and what the dosage should be. I feel strongly that this subject should be approached from a point of view of pure physics. I should like very much to see the Radiological Society undertake the problem of obtaining fundamental physical knowledge which will lead to a better understanding of the effects of various types of rays on normal and abnormal tissues. I believe this would be of far greater permanent value than the more definitely clinical and practical problems which are likely to scratch the surface, as so much radiological work has done in the past without making any deep impression."

(Signed)—G. CANBY ROBINSON,
Acting Physician-in-Chief.

The University of Kansas

"So far as I can see the problems of your society, one line of activity would be very gratefully received by Departments of Physics throughout the country. I do not hesitate to mention it, since in all likelihood the activities of this department would not put it in line to receive benefits from the fulfillment of the suggestion made; therefore, the department cannot be accused of prejudice in the matter. As you well know, one of the most serious handicaps under which research work in this country labors is lack of financial support. Very few universities are able to put into their research departments funds anywhere nearly adequate to carry on a well designed line of attack in any of the prominent fields of research. Here, then, is a field very prominent in its applications in medical and surgical science which is bringing in considerable funds to professional men who apply the results of research work. The question arises: can these same professional men afford deliberately to lay aside, each of them, a reasonable amount yearly—the members of old synagogues might call this tithing—this designed, however, to broaden the application of radiology and increase the returns to the profession! It should be looked upon as a good business investment! I cannot think of a more beneficial thing which the society could do than to establish a fund after this fashion, to administer it through a competent committee whose function would be to use good judgment in the distribution of grants from the fund to those laboratories where proficient work of research and developmental character could be carried out.

"The maintenance of a constant survey of research problems in the x-ray field, hinted at in the third suggestion of your letter of January 26th—the catalogue of problems resulting from such survey to be useful in avoidance of needless duplication of effort in various laboratories—would be a very beneficial thing. The results of this survey should, of course, be open to all institutions.

"The various laboratories of this country should be much interested in the activities of your society in keeping its members in touch with the problems of these laboratories, and I express again my appreciation of your letters of information and inquiry."

(Signed)—F. E. KESTER,
Department of Physics.

The University of Oklahoma

"It is important that the scientific basis for medicine and surgery be made as solid as possible, and this can be brought about only through research and diffusion of knowledge.

"The physics department of the University of Oklahoma is at present housed in very inadequate quarters and it is scarcely possible for us to do any research work along these lines.

"However, this places me in the position of wishing to emphasize the other side of the problem—that of the diffusion of knowledge.

"For some reason or other physics teaching in this country has been largely tied up with engineering. I do not mean that the courses are necessarily in conjunction with the engineering colleges, but that the engineering influence on text books and teaching is enormous. While I believe in the teaching of fundamentals, I do not feel that tradition should settle what the fundamentals are. Now that physics is required of all medical students we ought to teach them the fundamentals, amplified by and illustrated from the applications in medicine. Vacuum tubes, ionic theory, radioactivity, etc., should have a prominent place.

"The average teacher of physics is using what I term a text in 'physics with engineering applications and illustrations,' and if he is able to enrich the course from his own knowledge and experience it is likely to be along the lines of pure physics or engineering. Very few know the medical side.

"Therefore, for the sake of the future doctors who are all *forced* to take physics, I pray that you will make one of your functions the furnishing of teachers of physics with information enabling them to enrich their courses along the lines of medical experience and applications."

(Signed)—HOMER L. DODGE,
Professor of Physics.

Future Possibilities

It must be remembered that the foregoing constitutes but the results of a somewhat hurried and preliminary survey. It is not in any sense of the word conclusive. There are many scientific agencies which have not yet been approached simply because of the limitations of human flesh and blood. But a beginning has been made. From the assistance proffered, it is safe to assume there are numerous other reputable institutions, organizations, and individuals, sufficiently imbued with the true scientific spirit to be not only willing, but ready to perform their full quota in any such comprehensive and pregnant undertaking as that proposed.

As matter of fact, offers of assistance, suggestions of value, are received almost daily. It will be our pleasure to publish further data from time to time as it accumulates. In order to get to press, it has been necessary to draw the line somewhere. However, it seems safe to assume that the foregoing compendium is representative. For the moment the imperative thing would appear to be the formation of some definite policy and the creation of an elastic working organization, manned by sympathetic human beings, in order that the work thus begun under such fruitful promise may be carried on and made the foundation of a perpetual sponsor of real scientific achievement, ideals and progress.

The Place of Beginning

Anything like a thoughtful examination of the wealth of suggestions offered will disclose that there are two things immediately essential if the science of Radiology is to be established on a scholarly and scientific basis. They are:

1. The formation of a central bureau charged with the duty of assembly, collation, and dissemination of existing data concerning the various phases of Radiology, supported by scientific findings and case reports. Such a bureau must stand ready at all times to furnish specific data to all reputable scientific agencies and men on any and every phase of the science with which it deals.

2. The creation of an endowment fund, placed in trust, for the purpose of perpetuating scientific research designed to extend the science of Radiology diagnostically and therapeutically. Only the yearly accruals from the investment of this trust fund should be used, and that disbursed under the most careful scrutiny of men competent to judge the possibility of potential benefits inherent in the research proposed. These men will, of course, foster only those scientific projects which comport strictly with the ideals of the Radiological Society and the obligations of Radiology as a science.

Brief discussion of these two immediate problems may serve to show both their practicability and possibility. For this purpose, even at the expense of tedium, some concrete illustrations are set up.

Such a bureau should, for instance, on the subject of cancer research, assemble, compare, and check the findings of all agencies, institutions and men conducting scientific studies. It should gather data from pathologists concerning the action of x-rays, radium and electro-therapy on normal and abnormal tissues; the effects of radiation on the blood producing organs; and specific action of each kind of radiation on each kind of tumor. It should build up a symposium on the physiological causes for radiation sickness, with methods of prevention, including, of course, definite determination of the toxic causes; organ stimulation, etc.

On the purely physical side, that bureau should follow the progress of experiments looking to the establishment of absolute methods for producing radiation suitable for therapeutic work, the quality and quantity of radiation best suited for specific diseases, accurate methods for estimating dosage, and proper methods for protection of patient and operator.

By reference to a preceding subdivision, it will be patent that if such a bureau were to accomplish this result with respect only to the studies already reported in progress, to say absolutely nothing about the enormous amount undoubtedly going on which has not yet been reported and the large amount which will be instituted when those organizations interested in the development of the science evince their willingness to foster and encourage research in the various institutions which have proffered their assistance—if such a bureau in the beginning were unable to do more than this, it would render a very great service to the individual Radiologist, and go a long way toward making possible the establishment of the science of Radiology on a scholarly and secure scientific foundation. But it should go much further, and include within the scope of its inquiry the sciences of biology, bacteriology, chemistry, and electrical engineering. These sciences are equally important if the problem is to be viewed in its entirety.

Now, as to the question of funds—viewed in the sense of the sum of money which would be required to undertake all of these lines of endeavor immediately, perhaps it appears appalling. But considered as a budget, apportioned among all of the various individuals and organizations of the country directly interested in founding Radiology securely and permanently on a scholarly and scientific basis, it is anything but an impossible job.

A number of substantial offers of financial assistance have already been received from manufacturers of apparatus, equipment and therapeutic devices. But there is this one thought that is absolutely unanswerable: the members of this or any other similar organization cannot go to the outside world for financial support of an undertaking in which they are not sufficiently concerned to invest their own money. To do so would be to stultify their good name, disregard all thought of self-respect, and be in effect a disgusting offer to sell their birthright for a mess of pottage. Such an undertaking as the one in contemplation can never succeed on any such basis.

There are in this organization alone, approximately seven hundred men directly interested in the scientific development of Radiology to meet the imperious problems of diagnostic and therapeutic practice. In other similar organizations are a great many others. And outside of all organizations of this character are persons in large number willing and ready to give liberally in support of a real program of scientific research for the purpose of extending the field of applicability of Radiology. There are also many men and women throughout the country philanthropically inclined, who would feel it an honor to contribute in varying degrees commensurate with their capacities. So that the question of funds, while of prime importance, is probably the easiest thing accomplished, provided the members of the Radiological Society give unmistakable evidence of their sincerity in this program of scientific research to which they already stand committed before the world.

Certainly, no body of scientific men ever enjoyed an opportunity like that The Radiological Society of North America now enjoys, of getting for nothing the use of hundreds of thousands of dollars worth of equipment, apparatus, and laboratories, and the willing and intensely interested cooperation of the best scientific minds in the world, for the purpose of giving to humanity the results of collaborated and co-ordinated effort in the science of Radiology. To throw away that opportunity deliberately without a struggle to achieve at least a small part of its possibilities is unthinkable.

No great scientific undertaking has ever been achieved without some personal sacrifice. But the sacrifice necessary in this case is so insignificant compared with the personal benefits which will inevitably come to every man engaging in the science professionally that contributions to the fund cannot be viewed in this light. Money given for this work is an investment guaranteeing definite returns in daily practice, returns which, because of the fact that the funds are to be held in trust, will continue perpetually in ever increasing ratio.

Program—Summer Meeting

FRIDAY MORNING—MAY 19TH

9:00—"The Practical Dosage of X-rays"—Albert Bachem, Ph. D., Chicago, Ill.

9:30—"Combined Radium and Diathermy"—C. W. Hanford, M. D., Chicago, Ill.

10:00—"Treatment of Uterine Fibroids with Slides, Showing Original Appliances"—James M. McCoy, M. D., Vincennes, Ind.

10:30—"The Determination of the Intensity of X-rays of High Voltage"—Henry Schmitz, M .D., Chicago, Ill.

11:00—"The Inheritability of Spontaneous Cancer in Mice and Its Application to Man"—Maud Syle, M. D., University of Chicago.

11:30—"Cancer from the Standpoint of Etiology and Pathology"—L. Loeb, M. D., Washington University, St. Louis, Mo.

FRIDAY AFTERNOON

1:30—"Later Effects Upon the Respiratory Tract of the Chemical Gases Used in Warfare"—Gentz Perry, M. D., St. Louis, Mo.

2:00—"Gall-bladder Disease"—Robert Arens, M. D., Chicago, Ill.

2:30—"Evidence of Regeneration of the Mandible and Maxilla"—T. E. Carmody, M. D., Denver, Colo.

3:00—"A study of the Effects of Heavy Radiation on the Pleura and Lungs—A Preliminary Report"—A. F. Tyler, M. D., and J. R. Blackman, M. D., Omaha, Neb.

3:30—"An X-ray Demonstration of the Naso-Lacrimal Passageways—Normal and Obstructed" Howard P. Doub, M. D., Detroit, Mich.

4:00—"Radium and Roentgen Rays in the Treatment of Metastatic Testicular Tumors"—Henry H. Bowing, M. D., Rochester, Minn.

4:30—"The Surgical Aspect of Cancer"—A. J. Ochsner, M. D., Chicago, Ill.

SATURDAY MORNING—MAY 20TH

9:00—"The Use of High Voltages in Metrarrhagia and Fibroids"—F. H. Rodenbaugh, M. D., San Francisco, Cal.

9:30—"The Effect of X-ray on Cell Division"—Jas. W. Mavor, M. D., Schenectady, N. Y.

10:00—"Does Radiation Enhance Post-Operative Recurrence of Cancer of the Breast"—M. J. Sittenfield, M. D., New York City.

10:30—"Studies on the Effect of X-rays on Glandular Activity—

1—"A Critical Review of the Literature."

2—"The Submaxillary and Gastric Glands."

by

Drs. A. C. Ivy, B. H. Orndoff, A. Jacoby and J. E. Whitlow, Chicago. *From the Department of Physiology and Radiology, Loyola University School of Medicine, Chicago.* (With Lantern Slides).

11:00—Report of Committee on Research—A. F. Tyler, Chairman.

SATURDAY AFTERNOON

1:30—Title to be announced—W. S. Lawrence, M. D., Memphis, Tenn.

2:00—"Present Status of Radiation Therapy with Case Reports"—J. Thompson Stevens, M. D., Montclair, N. J.

2:30—"An Estimate of the Value of Perirenal Emphysema in Diagnosis"—L. T. LeWald, M. D., New York City.

3:00—"Radiotherapy in Carcinoma of the Larynx, with Special Reference to Needling Through the Thyroid Membrane"—Geo. E. Pfahler, M. D., Philadelphia, Pa.

3:30—"Protecting Patients from the High Voltage Line"—Albert Soiland, M. D., Los Angeles, Cal.

4:00—"Peptic Ulcer"—R. T. Wilson, M. D., Temple, Texas.

4:30—"Physical Measurements Associated with the Production of High Voltage X-rays"—Mr. Frank Rieber, San Francisco, Cal.

SATURDAY EVENING

Banquet.....Planters Hotel

Program—American Radium Society

Monday and Tuesday, May 22 and 23, 1922.
Headquarters and Place of Meeting
PLANTERS HOTEL — ST. LOUIS, MISSOURI

MONDAY, MAY 22, 1922
MORNING SESSION
(Begins Promptly at 9:30)

A.—EXECUTIVE SESSION.

B.—SCIENTIFIC SESSION.

1 "Lymphosarcoma and Other Glandular Enlargements of the Neck—Their Radiation Treatment."—Edward H. Skinner, M. D., Kansas City.

Discussion to be opened by Albert Soiland. M. D., Los Angeles.

2 "Experience with Radium in the Treatment of Bone Tumors."—Joseph C. Bloodgood, M. D., Baltimore.

Discussion to be opened by William S. Stone, M. D., New York. (By invitation).

3 "Treatment of Carcinoma of the Esophagus by Radiation."—Walter Mills, M. D., and John Kimbrough, M. D., St. Louis. (By invitation).

Discussion to be opened by Charles F. Bowen, M. D., Columbus, Ohio.

4 "Statistics and Technique in the Treatment of Carcinoma of the Rectum by Radiation."—Harry H. Bowing, M. D., Rochester, Minn.

Discussion to be opened by Douglas Quick, M. D., New York.

5 "Technique and Ante-Operative Radiation for Carcinoma of the Breast."—Russell H. Boggs, M. D., Pittsburgh.

6 "Statistics and Technique in the Treatment of Carcinoma of the Breast by Radiation, from the standpoint of the Surgeon."—Burton J. Lee, M. D., New York. (By invitation).

Discussion on these two papers to be opened by B. R. Kirkendall, M. D., Columbus, Ohio.

AFTERNOON SESSION

7 "Statistics and Technique in the Treatment of Carcinoma of the Uterus and Pelvis with the Combined Use of Radium and X-rays."—Henry Schmitz, M. D., Chicago.

8 "Statistics and Technique in the Treatment of Malignant Disease of the Uterus and Pelvis by Moderate Quantities of Radium."—John G. Clark, M. D., Philadelphia.

9 "Results of Treatment of Carcinoma of the Cervix, with Statistics and Technique."—Curtis F. Burnam, M. D., Baltimore.

10 "Statistics and Technique in the Treatment of Certain Benign Uterine Conditions by Radium."—Leda J. Stacy, M. D., Rochester, Minn.

11 "Statistics and Technique in the Treatment of Uterine Fibroids by Radiation."—James A. Corscaden, M. D., New York.

Discussion on this symposium to be opened by James T. Case, M. D., Battle Creek.

12 "Radium Therapy in Cancer of the Prostate."—Hermon C. Bumpus, M. D., Rochester, Minn. (By invitation).

13 "Statistics and Technique in the Treatment of Carcinoma of the Bladder by Radiation."—Benjamin S. Barringer, M. D., New York.

MONDAY EVENING

ANNUAL DINNER.

Address by the President, George E. Pfahler, M. D., "Protection in Radiology."

TUESDAY, MAY 23, 1922
MORNING SESSION

A.—SHORT EXECUTIVE SESSION.

B.—SCIENTIFIC SESSION.

14 "Statistics of the Intra-Oral Group of Carcinomas."—Douglas Quick, M. D., New York.

Discussion to be opened by Rex Duncan, M. D., Los Angeles. (By invitation).

15 "The Treatment of Infected Tonsils by Radium."—C. Augustus Simpson, M. D., Washington. (By invitation).

16 "Radium Treatment of Nasal Polyps."—H. R. Lyons, M. D., Rochester, Minn.

Discussion to be opened by C. Everett Field, M. D., New York.

17 "Statistics and Technique in the Treatment of Malignant Disease of the Antrum by Radium."—D. Crosby Greene, M. D., Boston. (By invitation).

Discussion to be opened by Henry K. Pancoast, M. D., Philadelphia.

18 "Statistics and Technique in the Treatment of Malignant Neoplasms of the Larynx."—Douglas Quick, M. D., New York.

Discussion to be opened by John M. Lee, M. D., Rochester, N. Y.

19 "Technique in the Application of Radium Needles."—William L. Clark, M. D., Philadelphia.

Discussion to be opened by Charles F. Bowen, M. D., Columbus, Ohio.

AFTERNOON SESSION

20 "Statistics and Technique in the Treatment of Malignant Disease of the Skin by Radiation."—Frank E. Simpson, M. D., Chicago.

21 "Statistics and Technique in the Treatment of Malignancy of the Skin by Radiation."—Howard Morrow, M. D., and Lawrence R. Taussig, M. D., San Francisco. (By invitation).

22 "The Treatment of Superficial Cancer, with Statistics and Technique."—D. T. Quigley, M. D., Omaha.

Discussion on this symposium to be opened by Ralph H. Stevens, M. D., Detroit.

23 "Comparative Measurements between Radium and X-rays Concerning Energy Absorbed at Depth."—Harvey R. Gaylord, M. D., and Carl W. Stenstrom, Buffalo. (By invitation).

24 "On Ionization Measurements."—Gioacchino Failla, E. E., New York.

Discussion on these two papers to be opened by Charles H. Viol, Ph. D., Pittsburgh.

25 "Proposed Collective Investigations of Certain Aspects of the Treatment of Malignant Disease."—Robert B. Greenough, M. D., Boston. (By invitation).

26 "The Present Field for the Use of Radium and the X-ray in the Treatment of Malignant Neoplastic Disease."—William S. Stone, M. D., New York. (By invitation).

27 "The Biological Effects of Radio-Active Substances and X-rays on Cell and Tissue Structures."—Leo Loeb, M. D., St. Louis. (By invitation).

28 "Two Important Points Regarding Cancer Immunity from the Radium Therapist's Standpoint."—Carroll Chase, M. D., New York.

Discussion on these two papers to be opened by Isaac Levin, M. D., New York.

DEMONSTRATIONS OF APPARATUS, APPLICATORS AND TECHNIQUE

1—Carroll Chase, M. D., New York: Illustrating new chart for use in radium therapy.

2—Dr. Carl W. Stenstrom, Buffalo: A new device for retubing radium emanation.

3—Albert Soiland, M. D., Los Angeles: Lantern slide demonstration; the protection of our operators from unnecessary radium radiation.

4—Sinclair Tousey, M. D., New York: Estimation of the safe dose of different radium preparations by photographic measurements.

5—Henry K. Pancoast, M. D., Philadelphia: A radium needle holder for laryngeal growths.

Military Roentgenology

DURING the American Medical Association week (probably immediately following the close of the session of the American Radium Society) the Military Roentgenologists of the United States will entertain at a "stag". Definite date will be announced.

Dr. W. H. Stewart, president of that organization, has conferred on our own Dr. Ernst the job of making necessary arrangements, and from present indications this will be the big social event of the week. The affair will be strictly informal and will typify all phases of army life, both at home and abroad, Paris included.

Every Military Roentgenologist is "eligible" though at the moment no information is imparted as to the qualifications implied.

Dr. William Duane

MEMBERS of the Radiological Society will be happy in the distinction accorded Dr. William Duane of Harvard, who was quite recently awarded the John Scott medal and certificate, with premium of $800.00, by the Board of Directors of City Trusts of Philadelphia for his researches in radioactivity and x-rays.

The award is made annually for scientific achievement in accordance with the terms of a bequest over a century ago by John Scott. Last year the winner was Mme. Curie.

Professor Duane has played a large part in the development of methods of using radium and x-rays in the treatment of cancer. He was the discoverer of a means of securing a new type of very penetrating x-rays for this purpose.

Dr. Preston M. Hickey

INFORMATION has just been received that Dr. Preston M. Hickey, of Detroit, has been chosen as successor to the late Dr. James G. Van Zwaluwenburg at Ann Arbor.

Felicitations are extended to both Ann Arbor and Dr. Hickey, to the Unitversity because of its rare choice, and to Dr. Hickey because of the wonderful opportunities such a connection assures. As head of the Department of Roentgenology at Ann Arbor, Dr. Hickey, who is now in Europe, will have excellent opportunity for applying the wealth of native ability for which he has long been recognized by his colleagues.

Detroit Radiological Society

The Detroit Radium and X-Ray Society has just been organized in Detroit, Mich. The officers for the ensuing year are as follows:

President.....Dr. P. M. Hickey
Vice President.....Dr. R. E. Loucks
Secretary-Treasurer.....Dr. J. H. Dempster

Persuasive Diagnosis

THE subtleties of thought and sophistication of presumptive knowledge are factors that operate in deductive reasoning, and, since the practice of medicine is so manifestly deductive, it at once becomes quite apparent that different opinions might be rendered by different persons, and these opinions be based upon the same findings.

It is, indeed, a fortunate situation that roentgenology, by means of the radiogram or the fluoroscope, appeals to that most stable special sense of sight. It is with a feeling of gratification that in a given case, there is probably more unanimity of opinion among roentgenologists than among most any other group of medical specialists. Visualized findings are so much more reliable and usually more capable of interpretation than auscultatory, percussive or palpatory findings. Because of this quality, undue enthusiasm on the part of some roentgenologists tends to discredit a valuable aid; on the other hand, conclusive reliance should not be placed on the roentgen ray findings alone.

As medical men, it is our privilege to get some data, such as anamnesis, clinical findings, and laboratory findings to assist us in attaining a more scientific diagnosis; of course, the findings and determinations should be given in roentgenological terms only; and these findings should be evaluated according to their certitude; if this cannot be done and several pathological processes are possible, they might all

be mentioned in such rotation as to indicate their probability.

In so doing the profoundest respect, consideration, and credit should be given to other specialists and to the doctor referring the case. This must constantly be borne in mind to avoid any hostility; due credence should be given where it belongs and when this is universally practiced, co-operation rather than competition will be the result. In correlating the roentgen and other findings, it is very *tempting to make definite conclusions* on findings other than roentgenological ones.

This practice is to be condemned if used unqualifiedly. It is this very thing that casts suspicion on meritorious roentgen work. *This method reads a diagnosis into the plate and fluoroscopic examinations, rather than reading a diagnosis out of the plate and fluoroscopic examinations.*

In other words, it is the border-line or vague case, that demands a frank admission of limitation; and it is in just such cases that the roentgenologist will have a surging tendency to make his findings conform to a prior tentative diagnosis. It can readily be seen, if one is justly indecisive, how the clinician or surgeon with the most sincere and honest intentions can persuade a roentgenologist to make a decision which is quite arbitrary. In so doing, misleading conclusions are made and if, in this instance, surgical verification is made, one is credited with a spectacular, although unjustifiable, diagnosis; however, it is more often the case, that the operative findings do not support the so-called roentgen findings, thereby discrediting x-ray work in general. It is a peculiar psychological fact that one error more than offsets the value of numerous correct diagnoses. If this is true, would it not be advisable to adopt and use such methods and information as are *definitive*, and, if such do not exist, then acknowledge the inability to reach a definite conclusion.

Instead of bluffing or making a questionable positive diagnosis, it should be considered better to make a negative diagnosis. The phrase, "I don't know," will avoid many castigations and is used by the really great man or the ignorant, and when used by the former does not cast a blemish on his escutcheon.

It should be the privilege of the roentgenologist to suggest, advise, and to expect continued or repeated observation of a patient, as in some cases it may require a lapse of time to produce x-ray manifestations, for instance, in osteo-myelitis; in other cases, the permanency of an x-ray manifestation may be in doubt, for instance, it may be necessary to decide between a gastric spasm (intrinsic or extrinsic) and a gastric neoplasm. It can readily be seen that this is quite vital.

In conclusion, for the promotion of confidence, let's be sure we are right, then go ahead. If in doubt, say so, and when we don't know, it is no disgrace to acknowledge it.

M. J. HUBENY.

Proposed Questionnaire to Nursing Profession

THE Radiological Society of North America has appointed a committee to study the relationship between roentgenologists and technicians, and has voted to co-operate with the American Association of Radiological Technicians. A Board of five has been appointed for the examination, certification, and control of ethical x-ray technicians; and for the recognition and endorsement of qualified laboratories as training schools, both physicians' private laboratories and in hospitals.

Among the proposed requirements to be laid down by the Board are the following: Candidates must agree to work only under direct medical or dental supervision; they must agree not to give out written or oral diagnoses; they shall be twenty-one years old; they shall have the equivalent of a high school education and that of a registered trained nurse. By the equivalent of a trained nurse is meant those x-ray technicians, male and female, who have already been brought into the work by the medical profession and who are trained, experienced, and committed to this line of work.

Since the nurse and the physician are the only ones legally and professionally qualified in all states to handle the sick under all circumstances, since the nurse is trained in the etiquette of a physician's office and is not handicapped in handling female patients in all stages of exposure as is the male technician, since the trained nurse in many ways can fit into the routine of both a doctor's office and a hospital, where she has a definite standing—for these and other reasons that may occur to you, we are preparing to commit ourselves to the stand of accepting only the trained nurse as a candidate for certification for the future. Before doing this, however, we want to sound out the attitude of the nursing profession, and we are, therefore, asking you to consider the accompanying questionnaire carefully and give it your earliest attention, as this matter must come up for the Executive Committee meeting of The Radiological Society at St. Louis in May, 1922.

X-ray technical work is a combination of the following, in order of importance: (1) Mechanical aptitude with ability to learn the use of electrical apparatus on a precision basis, the elements of photography and developing; (2) Nursing training and etiquette; (3) General executive ability, since many laboratories require several technicians and need a chief technician.

To an apprentice with no x-ray training we favor the following: *No charge* for training, but *no salary* for the first three months; a moderate salary to cover living expenses for the next three months or more until the course is finished, depending on the ability and aptitude shown.

It is hoped that the nursing profession will not set its salary requirements so high, either in the state of apprenticeship or as licensed technicians, that its services will be prohibitive. It is obvious that while this is a specialty, it will probably not command as large a salary per month as private bedside nursing. If nurses demand salaries in excess of the ordinary doctor's ability to pay, the medical profession will have to fall back on male technicians, undergraduate or sub-nurses, and laymen who have had not proper training in the care of the sick or in professional ethics.

The trained nurse technician would be in a responsible position, would have to learn to do many things well, and the future would seem to offer continued demand for her services. X-ray work is all-the-year-round work and may appeal to nurses for the following reasons:

1—A change from routine nursing.

2—A seven to eight hour day, no Sunday or holiday work except an occasional emergency; no night work.

3—Lighter work for the physically handicapped, which would enable a nurse to continue active for a longer time than is possible in private nursing.

4—It is in the nature of a specialty requiring study and continual progress, and should bring adequate reward financially to those of superior ability.

Kindly fill out the enclose questionnaire and return at your earliest convenience. In addition will each radiologist have his technicians answer the questions either singly or in a group. This will greatly aid the committee.

Very truly yours,

BYRON C. DARLING, M. D.,

Secretary, Board for the Examination and Control of X-ray Technicians, 104 East 40th St., New York City.

QUESTIONNAIRE

1 (a) Do you agree with the policy expressed in the accompanying letter?

Why?

If not, in what particulars do you disagree?

(b) What constructive suggestions have you to make?

(c) Would you advocate the general use in doctors' offices and hospitals of a male technician?

If not, what reasons have you for your position?

2 (a) Do you think that nurses with mechanical aptitude would favor x-ray work as a desirable kind of post-graduate work?

(b) Would they be willing to serve a probationship and an apprenticeship without pay?

(1) If so, for how long?

(The shortest course should be at least six months.)

(2) If not, what terms would you consider fair in this period of instruction?

(Such a pupil would be of little technical help to the laboratory for the first three months.)

3 What would be considered a fair salary for a nurse doing x-ray work in a doctor's office or institution from nine to five-thirty daily, one-half day off a week, no work on Sunday or holidays, provided she had had one and one-half years experience and had been certified by the Board?

(At the present time the average salary in large cities in the east is from $150 to $175 a month without maintenance, or $100 to $125 with maintenance. Outside of large cities or in the west the average is possibly $50 a month more.)

(a) Without maintenance?

(b) With maintenance?

4 Additional remarks or suggestions:

NEW EQUIPMENT

A New Wappler Composite X-Ray Unit

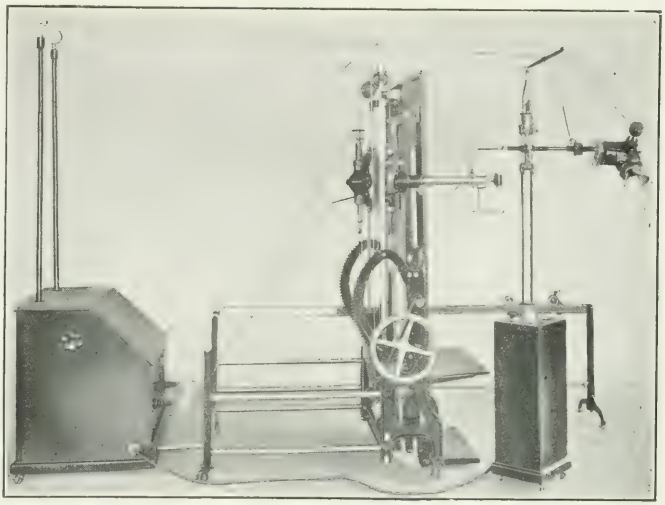
A NEW apparatus has been developed in the laboratories of the Wappler Electric Co., which represents a further step in advance in x-ray apparatus useful for a great variety of purposes.

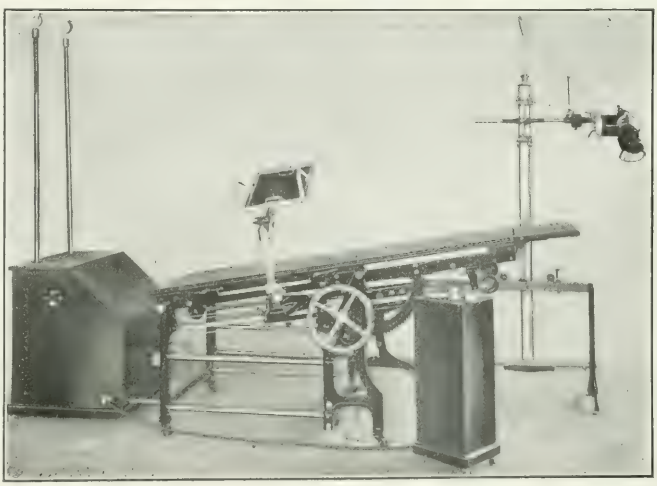
Reference is had to the Wappler Composite X-ray Unit. It consists of a radiographic and fluoroscopic transformer equipped with insulated high tension masts and a high tension switch so that merely by turning a hand wheel the current can be directed either to the fluoroscopic apparatus beneath the table or to the radiographic tube supported in a counterbalanced tube shield located above the platform of the table. The control of the transformer is by means of a small portable control stand containing control switches, meters, and an auto transformer equipped with a special stabilizing feature insuring independent control of the tube current (ma.) and the penetration (back up) of the rays. This control stand can be moved about and placed so that it is convenient either when making fluoroscopic examinations or when making radiographic exposures.

The table itself is mechanically very much improved. The improvements are brought into prominence in the form of the new tilting device for the table and the improved screen and shutter holder. The table top is of wood and can be tilted by turning a wheel, gradually and surely changing the position of the table from horizontal or vertical or any desired intermediate angle. Additional flexibility can be secured by releasing a pair of stops which stop the table in the horizontal position, that is, so that the patient's head is considerably lower than the abdomen, and in this way the very useful Trendelenburg position is obtained. The table top is firmly held in the desired position by a secure locking device so that accidents due to unexpected tilting of the table are absolutely impossible.

The shutter device has been materially improved by the construction of a metallic funnel through which all secondary and side radiation is effectively held back. The gray appearance of the fluoroscopic image which very often makes the fluoroscopic examination of heavy patients difficult or impossible is effectively checked. Examination of this shutter reveals that a decidedly better and clearer fluoroscopic image can be obtained with this improved shutter and shield. The screen itself is absolutely flexible. It can be placed in any desired position and the area covered by the fluoroscopic tube and shield is large enough that the entire trunk of a patient can be examined fluoroscopically without shifting the patient.

For radiographic work the screen arm can be removed. After changing the high tension switch the radiographic tube can be used above the table and all radiographic examinations feasible with the thirty ma. radiator type Coolidge tube can be made accurately and securely with a minimum loss of time





involved in changing from one position to the other or from the fluoroscopic to the radiographic setting. The floor space required for this unit is ten and one-half by four feet. If the unit is required only for fluoroscopic work it can be connected to an existing house line, but if the thirty ma. radiographic tube is to be used for radiographic work a line with a carrying capacity of about three k.w. must be provided.

The x-rays, with full justification, have become known as a positive means for diagnosis and their successful application depends to a very large extent on the design and development of apparatus applicable to the great variety of examinations which the medical practitioner is required to make. Thus, for establishing accurate and correct diagnosis a number of different methods of applying the x-rays must be feasible. As an example, for the examination of the visceral organs, especially with regard to their position and mobility, there is required a fluoroscopic device which enables one to place the patient in various positions, from vertical to horizontal, and even in the Trendelenburg position. A change of position from erect to horizontal may reveal the extent of mobility of the viscera, but for observing smaller lesions *in extenso* it is often advantageous to use some method which gives better details and permanent records for leisurely study.

The progress made in transformer design, in tubes and in intensifying screens and films, etc., makes it possible (with equipment which occupies comparatively small floor space, is easy to operate and relatively inexpensive) to make practically all the tests and examinations which are of importance to the diagnostician. In addition to that, the working out of adequate examining apparatus, such as tilt tables which are safe to operate and easy to manipulate, has greatly facilitated the application of the x-rays.

This unit has been found very useful in the office of internal medical men, surgeons or orthopedists and general practitioners, chiefly, because of its almost universal applicability and because of its ease of operation.

Waite and Bartlett Mobile Radiographic Unit and 20 Inch Interrupterless Machine

A MOBILE radiographic unit, similar to the one made by the same company for the United States Army, has been recently brought out by Waite and Bartlett Manufacturing Company. This unit is twenty-four inches wide, twenty inches deep, twenty-eight inches high, and is mounted on roller bearing wheels ten inches in diameter.

In the bottom of the cabinet is a thirty-five foot reel so that it can be easily connected with the service. The tube stand is made in two parts, and instead of the usual counter-weight as a counter-balance ,a special spring is mounted on the top of the standard. The tube carrier part is arranged so that it automatically locks on the stand without requiring any thought on the part of the operator.

There is a milliammeter, volt meter, auto transformer with two volt steps, a double pole overload circuit breaker, a hand time switch with a stereoscopic reset, and arranged so that in addition to pressing on the push button, there is another contractor that the operator has to hold. This is for safety, so that one not acquainted with the apparatus could not put it into operation by simply pressing the push button.

Another piece of apparatus being introduced by the same company is a twenty inch interrupterless machine, which has several novel features. First, the transformer is made up in two units, having both terminals developed. This is in contra-distinction to the Waite and Bartlett ten inch machine, which has two terminals, but each transformer has only one terminal developed. The advantage of having both terminals developed in the twenty inch machine, is that each transformer represents practically a ten-inch transformer. Then the rectifying shaft has four cross arms, each pair of cross arms commutating the high tension current from each transformer. After this current has been rectified, the two ten inch circuits are connected in series and grounded. This enables the Waite and Bartlett Company to place the milliammeter on the low tension switchboard and use the regular direct current milliammeter.

The theory advanced in support of this method of construction is that it enables the operator to make accurate readings and does away with the difficulties encountered when the meter is cut in on the high tension circuit.

The cabinet housing this machine is only thirty-two inches wide, five feet eight inches long, and four feet six inches high. This machine is conspicuously quiet in its operation.

High Tension Electro-Surgical Scalpel

A NEW electro-surgical instrument that will be of great interest to radiologists and surgeons has been perfected by the High Tension Transformer and Equipment Company of Hoboken, N. J. This instrument has been named the Electro-Scalpel. It is particularly valuable in operating upon cancerous growths and in abdominal work. It makes a clean incision such as would be made by a sharp scalpel, or, by simple adjustment of the current control, a cauterant effect may be produced. No edge is needed on the blade, as the cutting is not done by pressure. The tissues are divided ahead of the progress of the blade by a special, rapidly oscillating current of delicately attuned frequency, but of comparatively low voltage. In fact, the voltage is not great enough to puncture a piece of paper against a grounded plate.

Many laboratory tests and limited clinical use in abdominal operations and tumors upon other parts of the body have proved that the Electro-Scalpel is reliable under all circumstances. The incision made is clean, with no visible sloughing of the marginal tissue, and, when it is desired, the instrument may be adjusted to produce coagulation to any desired extent. Another new feature of this instrument is that the blade does not become hot and, instantly upon turning off the current, it may be applied to any part of the body without any sensation of heat.

The range of usefulness of this instrument in surgical work seems to be unlimited, as it may be regulated to all types of operations, from the most delicate, such as on or around the eye, to heavy tumor work, and the blade may be designed to suit any requirement.

The nature of the current used is said to be new to electro-surgical instruments and its application opens a field which is not at present covered by any other appliance.

The Electro-Scalpel will be demonstrated at the mid-year meeting of the Radiological Society in St. Louis, May 19th to 22nd.

High Tension Intermediate X-Ray Unit

THE following letter just received from Mr. Casper S. Spangler of The High Tension Transformer and Equipment Company of Hoboken, New Jersey, alludes to a discussion on the above apparatus, which appeared in the April issue of the Journal of Radiology. It is self explanatory.

"We are very much displeased with the gross misrepresentation of our Intermediate X-ray Unit which you printed in the Journal of Radiology, April issue, page 149.

"The statements made in the article are incorrect and entirely misleading. The author of the article has apparently paid no attention to the information we furnished you with our letter of February 18th.

"Referring to the article as it appeared in the Journal, beginning with the second paragraph the statement is repeatedly made that rectification is accomplished by means of the Rotary Wave Selector *in the primary circuit.* It is in the secondary circuit of the transformer although it is not placed *across* the secondary terminals. Throughout the article reference is made to rectification in the primary—the author going so far as to mention 220 volts as the potential at which rectification is accomplished. This is not true. Furthermore, inferences and conclusions are drawn in regard to the effect on the wave form, which, while they might invite discussion if rectification were actually made in the primary, have no application in the true case. The author shows no understanding of the principle of rectification applied in this machine, and we are at a loss to understand why such statements have been printed when correct information was at hand for his reference.

"Already we have received a letter from a prominent physicist calling our attention to 'the grossly incorrect statements on page 149 of the Journal of Radiology, April issue.' Our correspondent further says, 'I hope you will call the editor's attention to these errors and have him correct them in the next issue.'

"We appreciate the letter quoted and it is hardly necessary for us to remind you that the majority of readers have not been previously as well informed as this scientist whose business it is to know this subject.

"Will you please refer to our write-up, mailed with our letter of February 18th, as well as to the enclosed booklet, and correct in your next issue the entirely erroneous impression that has been created?"

The following are the essential excerpts from the statement to which reference is made:

"One of the distinctive features of the Intermediate Unit is the simplified method of rectification by means of the new rotary wave selector. It replaces the usual large mica discs or arms with a small moving member driven by a one-thirtieth horse power synchronous motor, which is practically noiseless.

"Because of the electrical design of the Intermediate the rectifying device is never called upon to withstand the total potential of the transformer, because, while it is a part of the secondary circuit, it is not placed across the secondary terminals. It is made a part of the transformer itself. This accounts for its very small size and makes it possible to deliver a uni-directional high tension current directly from the secondary terminals of the transformer to the tube. This is a feature in rectification that heretofore has been considered impossible.

"In therapy this rectifier is especially valuable in that the soft or long rays generated by the lower parts of the wave are eliminated. * * *

The Journal is glad to make this correction. It would be very grateful, however, if the High Tension Company would give it for publication, a detailed and specific statement of its method of construction, method of rectification, etc. It is not the policy of the Journal to close the door on any development of apparatus, but rather to kick it open and keep it open.

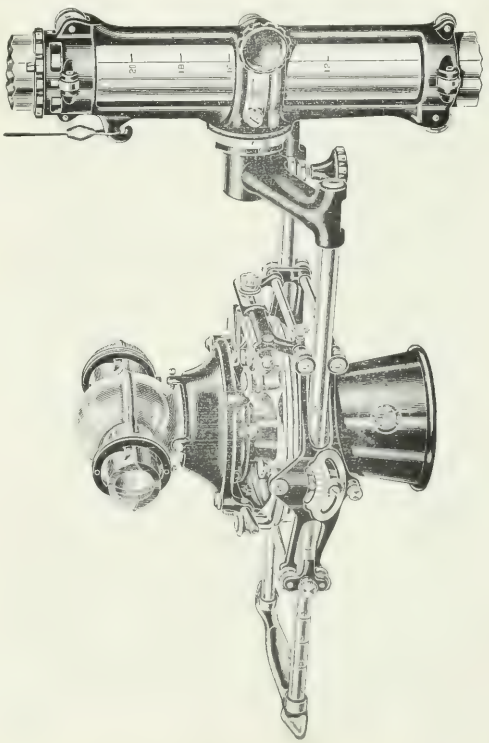
New Acme Tube Stand

THE introduction of the stereoscopic movement of the Acme No. 1 Radiographic and Stereoscopic Tube Stand marks the advent of an improved method of stereoscopy.

Tube stands as now constructed are arranged to move the focal spot of the x-ray tube two and one-half inches between exposures, regardless of the distance between the target of the x-ray tube and the plate or film. The stereoscope reproduces optically the conditions under which the radiographs were taken. Radiographs made in accordance with the present day technique cannot be correctly viewed in present day stereoscopes. The technique now calls for most stereoscopic work to be done at from thirty inches to thirty-six inches distance. No stereoscope is now made in which the distance from the center of the mirrors to the face of the box exceeds twenty-four inches. In order to reproduce the conditions, however, this distance must be from thirty inches to thirty-six inches.

The method of stereoscopy embodied in the No. 1 Acme Tube Stand bridges this gap. The optical principles underlying stereoscopic work have been thoroughly analyzed and applied.

The method consists in setting the viewing boxes of the stereoscope at a fixed distance and then calculating the various shifts which the tube stand head will make at various distances between target and film in order that the line of the central beam of x-rays will always coincide with the line of vision as reproduced in the stereoscope boxes at this fixed distance. In other words, the stereoscopic shift mechanism has been so constructed that although the exposures were made at thirty-six inches the tube shift is such that a practically true stereoscopic image is obtained at



the "fixed" viewing distance of twenty-four inches. In that way distortion is cut to a minimum and an essentially true stereoscopic image obtained with the standard stereoscope. All of the advantages of long distance between target and film are secured without the loss of a true stereoscopic image when viewed in a standard stereoscope.

This increase in flexibility and utility has entailed no sacrifice in simplicity. The setting of two stops in accordance with the target to film distance makes all necessary adjustments for the making of a set of exposures.

AIR CONTROL FOR VERTICAL STEREOSCOPY

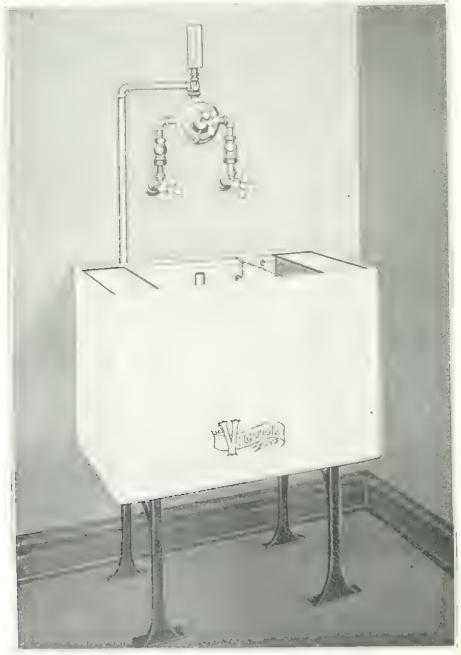
The Air Control for Vertical Stereoscopy for the No. 1 Acme Radiographic and Stereoscopic Tube Stand is another achievement of Acme Engineers. The need of a device of this nature has been recognized but never really filled. The Acme Stand, however, was designed with this end in view. The air control is mounted directly on the tube head and can be instantly thrown into and out of engagement. It is easily set and operated and gradually checks the descent of the tube head so that there is no jarring, the head moving down noiselessly and coming to rest without a sign of vibration.

Victor All-Metal Developing Unit

A MUCH needed dark room fixture has been added to the Victor line in the shape of an all-metal developing tank—a tank constructed of iron and heavily enameled. Such a tank will not, of course, absorb the chemical solutions and can be kept immaculately clean and sweet smelling without difficulty.

The accompanying illustration shows the Victor tank installed. The solution tanks are interchangeable and are held in position by a ledge on the master tank. There is ample room, it will be observed, between the solution tanks for suspending film hangers. A constant flow of water in the master tank controls the temperature of the solution in the developing and fixing baths through a thermostatic mixing valve set into the water line. By setting the thermostat at the degree of temperature desired, the flow of hot and cold water is regulated by the mixing valve, and if, for any reason, the supply of hot or cold water fails, the mixing valve mechanism cuts off the other supply so quickly that less than one degree change in the temperature level of the tank occurs.

The tank is sold under a guarantee against chipping, cracking or checking.



The Improved Patterson Intensifying Screen

MEDICAL radiologists will doubtless be interested in knowing that The Patterson Screen Company of Towanda, Penn., has achieved another development in the manufacture of intensifying screens.

The development has to do with the "Patterson Cleanable" screen put on the market in September of last year. It will be remembered that while the "Patterson Cleanable" screen as first presented produced excellent negatives, it was slower than the older or unprotected screen. As the Journal is informed, a new process has been discovered whereby certain protective features are worked into the virgin chemical, making it not only cleanable, but practically impervious to dirt, and at the same time have a speed factor equal to that of ordinary screens. The new screen is thin and pliable, has sufficient strength to insure reasonable longevity, dust, ashes or floor dirt will not adhere to its surface, and smear marks such as pencil, crayon or similar substances can be washed off without damaging the screen.

To some extent all screens may be cleaned, even the unprotected ones. But it does not necessarily follow that washing removes all the dirt. A screen can, too, be protected to a certain degree by the use of a transparent celluloid covering, but the screen may get dirty before or during the covering process or dirt may work between the celluloid covering and the screen, imbedding itself in the fluorescent emulsion. There are some objections, however, to the celluloid process, chief among which are that the celluloid covering absorbs considerable of the actinic light given off by the screen, and the celluloid scratches readily and is subject to seasoning and warping processes.

As stated, The Patterson Company obviates these disadvantages by embodying the protective qualities of its new screen in the chemical from which the screen is made.

The Patterson Company has been guided in its exploratory work by the observations made by Prof. Shearer of Cornell University, in France during the time he had charge of this part of the military service.

ABSTRACTS and REVIEWS

IN a letter to the editor of the Journal, Dr. N. E. Dorsey criticizes a statement originally made by Dr. L. C. Donnelly in his paper on "Ultra Violet Ray Therapy, an abstract of which appeared on page fifteen of the March issue of the Journal. To quote Dr. Dorsey:

"The gist of the matter will be found near the end of the second paragraph, where it is said that 'the red blood cells *absorb and conduct the rays* to different parts of the body.' (The italics are mine). This implies that the light is soaked up by the cells, somewhat as water is soaked up by a sponge, and is then transported by the motion of the cell as the water is transported by the motion of the sponge. Such an idea is totally wrong. Light, x-rays, gamma-rays, all consist of wave motion in a medium; they can be no more absorbed in something and transported by it, than a water wave can be bottled and carried. When these waves encounter material bodies, they may set up motions in them, may even tear them to pieces, and in so doing these waves expend their energy, are used up; to the extent to which they produce such effects the waves cease to exist as such. It is this spending of the wave, the using up of its energy in the production of changes in the material through which it is passing, that is described technically as the absorption of the wave by the material. When the wave is absorbed it ceases to exist, the energy that it carried has been converted into other forms. The absorption of the rays by the blood cells may result in changes in the chemical structure of the cells; and these modified cells may be carried to other parts of the body, but the ultra violet rays are not carried."

Roentgen Ray Intoxication. Unit Dose Over Thorax Negative—Over Abdomen Lethal. Epithelium of Small Intestine Sensitive to X-rays. S. L. Warren and G. H. Whipple, M. D. *From Hooper Foundation for Medical Research, San Francisco.* J. Exper. Med., Feb., 1922, p. 187.

A STUDY of non-specific intoxications was being carried on at the Hooper Foundation at the time this paper was written and the work here recorded forms a part of that study.

This particular study is an investigation of the systemic intoxication which develops after exposure to large doses of hard roentgen rays. Normal dogs were used throughout these experiments, rabbits not being considered favorable animals for this study.

The fundamental factor in the systemic intoxication which develops after exposure to x-rays was found from these experiments to be a primary injury to the epithelium of the small intestine. The stomach and colon were found more resistant than the small intestine. The factors of red bone marrow, lymphatic tissue, and circulatory blood were ruled out by this study, as were also the liver, pancreas and adrenals. A very interesting fact noted is that even with all the epithelium destroyed many clusters of lymphocytes remained, but it is remarked that lymphocytes in different parts of the body may have varying susceptibilities to radiation.

The conclusions reached by the authors were as follows:

Roentgen radiation of the thorax (abdomen shielded) in dogs, even with large doses (up to five hundred and twelve millampere minutes) gives no clinical evidence of intoxication. There may be a transient leucopenia and a slight rise in urinary nitrogen.

Roentgen radiation of the abdomen (thorax shielded) in dogs, with a dose of three hundred and fifty milliampere minutes, will almost certainly cause a fatal intoxication. Smaller doses may be survived, but usually with signs of gastro-intestinal intoxication.

This lethal intoxication, due to abdominal radiation, presents a remarkably uniform clinical and anatomical picture. There is a latent period of from twenty-four to thirty-six hours during which the dog is perfectly normal clinically. The second day usually shows the beginning of diarrhea and perhaps some vomitus. The third and fourth days show progressive intoxication with increasing vomiting and bloody diarrhea until the dog becomes stuporous. Death is almost always on the fourth day.

Anatomically the only lesions of significance are to be found in the small intestine. The epithelium of the crypts and villi show more or less complete necrosis, and this condition may involve almost all of the small intestine. The epithelium may vanish completely except for a few cells here and there which have escaped and are often found in mitosis, probably an effort at repair and regeneration.

The writers were forced to the conclusion that this remarkable injury of the epithelium of the small intestine is responsible for the various abnormal reactions and final lethal intoxication which follows a unit dose of roentgen radiation over the abdomen of a normal dog. This sensitiveness of the intestinal epithelium to x-rays is not appreciated and should be given proper consideration in clinical work.

Roentgen Ray Intoxication. A Study of the Sequence of Clinical, Anatomical, and Histological Changes Following a Unit Dose of X-rays. S. L. Warren and G. H. Whipple, M. D. *From the Hooper Foundation for Medical Research, San Francisco.* J. Exper. Med. Feb., 1922, p. 203.

THE conviction reached by the study abstracted above, namely, that the initial injury of the epithelium of the small intestine is responsible for the severe clinical reaction and lethal intoxication following exposure to the roentgen ray, was deepened by further experimentation with normal dogs exposed under the same conditions as before. In this series the reactions were carefully studied, the histological and gross changes from day to day being recorded. Controls were used throughout. Authors' conclusions follow:

Roentgen radiation in lethal dosage, given over the abdomen of a normal dog, is followed by a physiological reaction of remarkable uniformity.

The first twenty-four hour period following exposure is negative clinically and anatomically, but histologically we see frank changes in the bone marrow, spleen, lymph glands and ovaries. There are definite nuclear changes with degeneration in the crypt epithelium of the small intestine.

The second twenty-four hour period shows a slight clinical disturbance of gastro-intestinal nature (vomitus and diarrhoea). The mucosa of the small intestine shows scattered ecchymoses, but the histology of the small intestine is important. The necrosis of the crypt epithelium may be almost complete, while the epithelium of the villi remains practically intact. There is a little edema and invasion of wandering cells.

The third twenty-four hour period shows increasing clinical disturbance with vomiting and bloody diarrhea. Anatomically the small intestine from

the edge of the pylorus to the rim of the ileocecal valve looks raw, red and inflamed. The crypt and the villous epithelium have in large part vanished, leaving a collapsed framework of the mucosa showing a little edema and invasion of wandering cells.

The fourth day marks the peak of the intoxication, and death usually follows at this time, preceded by coma. Anatomically and histologically the picture is like that of the third day. There is more evidence of mitosis and efforts at repair on the part of the intestinal epithelium. It is thought that this reaction may be due to absorption of toxic substances and invasion of bacteria from the lumen of the injured intestine, though the writers believe there are other possibilities and these are to be made the object of further study.

The stomach is not concerned in this reaction, but the colon may show evidence of a slight injury. The colon is evidently much more resistant than is the small intestine.

The authors believe the evidence is conclusive that the injury done the epithelium of the small intestine is wholly responsible for the stormy clinical picture and fatal intoxication.

Roentgen Ray Intoxication. Speed of Autolysis of Various Body Tissues After Lethal X-ray Exposures. The remarkable Disturbance in the Epithelium of the Small Intestine. S. L. Warren and G. H. Whipple, M. D. *From the Hooper Foundation of Medical Research, San Francisco.* J. Exper. Med., Feb., 1922, p. 213.

IT is specifically stated that the study of reactions of ferments in "dead or dying cells cut off from circulatory influences" may or may not lead to truly scientific conclusions. With this held in mind the evidence is here submitted to show that cell autolysis in the epithelium of the small intestine is profoundly modified by x-ray exposure.

This study was carried out on sections of the organs of dogs used in the preceding study above. Controls were used and to prevent bias and eliminate mistakes almost six hundred slides were studied as "unknowns" and not only that but were reviewed three times.

Fibroblasts, mature connective tissue cells, endothelial cells and macrophages, muscle tissue and certain white blood cells were not much, if at all, disturbed by the exposure. Some of these cells are generally supposed to be poor in ferments, but not all of them. The clinical symptoms always reach a crisis on the fourth day, and if this period is survived the dog usually recovers.

The following summary is given:

Exposures to large doses of x-rays will cause notable increase in the speed of autolysis of the crypt or secretory epithelium of the dog's small intestine. These changes can be demonstrated readily in material obtained from dogs killed, two, twenty-four, forty-eight, seventy-two or ninety-six hours after the initial radiation.

In the radiated dogs the secretory crypt epithelium of the small intestine autolyzes first and the epithelium of the villi last, while the reverse is true in the normal control of the small intestine. These abnormalities of autolysis associated with lethal roentgen ray exposures can be demonstrated for the small intestine over the whole four day period subsequent to radiation.

The colon shows little change and the stomach no demonstrable change in autolysis under like conditions. The kidney, likewise, is negative.

The spleen, lymph glands, liver and pancreas show a moderate increase in speed of autolysis in tissues taken from radiated animals within forty-eight hours of the initial exposure.

What the significance of this disturbance of cell ferments in the intestinal mucosa may be is not known, but these observations strengthen one's confidence in the profound functional disturbance of this important intestinal epithelium—a disturbance which the writers believe is responsible for the clinical abnormalities and fatal intoxication.

Notes on the Clinical Value of Radium in the Management of Uterine Hemorrhage. Some End Results. John Osborn Polack, M. S., M. D., F. A. C. S. Med. Rec., March 25, 1922, p. 493.

RADIUM has an established place in the treatment of uterine hemorrhages, whether from fibroids, myopathic bleeding, or subinvolutions and fibrosis of the uterus. It is also valuable in leucorrhea resulting from cervical inflammation.

The author holds that operation is at times the only method of procedure, but he believes that it breaks down the individual's resistance to malignancy, hence recurrence and metastases unless all trace of malignancy has been removed. He believes it is only a matter of time until radium will entirely replace surgery in cancer therapy.

The experience here recounted covers a period of six years use of radium element in quantity varying from one hundred to one hundred and fifty milligrams and does not include any deep therapy cases.

Thirty-one cases of myopathic hemorrhage in young girls were treated. The average dosage was four hundred milligram hours and one application sufficed for cure in all but one case, which required three. That the menses recurred regularly, and that six of these cases are now married and two pregnancies reported is offered in answer to probable criticisms.

He regards operation as the procedure of choice in most myomata and states that the following disadvantages accompany radium: (1) It produces edema and inflammatory reaction and increases toxemia. (2) Trouble may arise from the presence of nodules outside the uterus. (3) Malignant or other complications may escape notice. (4) Radium in sufficient dosage impairs reproduction. (5) It is too slow in action if pressure symptoms require relief. (6) If necrosis is present radium increases it.

But *if proper selection is made* radium has the following advantages: (1) No operative mortality. (2) No general anesthetic. (3) No post-operative complications. (4) Prompt control of uterine hemorrhage. (5) Menopausal symptoms not so marked. (6) Shrinkage of tumor in sixty-five per cent of intramural cases with absolute cessation of hemorrhage. (7) Should radium fail operation is still possible. Radium is the treatment of choice in all cases of myomata complicated by heart disease, extreme anemia, diabetes and chronic nephritis.

Radiation of fibroids the writer has confined to tumors not larger than a four months pregnancy, growths definitely intramural with no subperitoneal nodules of any considerable size, and to sessile submucous tumors. Of one hundred and six cases treated with two thousand to three thousand milligram hours, only two have needed subsequent operation. In eighty of the others the tumor shrunk to one-half its original size, and in twenty it entirely disappeared.

Radiation has been applied in two hundred and sixty cases of bleeding resulting from sub-involution and fibrosis of the uterus without lateral or posterior parametritus or history of pelvic inflammation. Bleeding has in all cases been checked. The majority of the uteri have been sessile in character and menopausal symptoms have appeared. Several of these cases have been later submitted to operation for correction of the descensus.

IN The American Journal of Public Health, April, 1922, page 320, W. F. Walker of the Detroit Board of Health reports upon a study made on the water of one of Detroit's swimming pools. An attempt was made to sterilize the water by the use of ultra violet

rays and results, according to the bacteriological tests, are interesting.

All contributory factors were taken into consideration in this study and it is felt that the basis for study was kept constantly uniform. In 1916, before the installation of the ultra violet ray sterilizers, the bacterial test (yearly average) showed B. coli 350 for each 100 cc. of water. In 1921, after the installation of the sterilizers, all other factors remaining practically the same, the bacterial test showed B. coli .75 for each 100 cc. of water.

Mr. Walker states that "sterilization by ultra violet rays of swimming pool water in a recirculation system, properly designed and operated, gives a water in the pool which compares favorably with the government standard for drinking water."

The Pathological Gall-Bladder Roentgenologically Considered. By Arial W. George, M. D. and Ralph D. Leonard, M. D. Cloth, octavo. Publisher, Paul B. Hoeber, 67-69 E. 59th St., New York City. Price, $10.00 net.

THE actual text of this monograph covers some thirty-seven pages. The atlas, with a brief introductory text printed in English, French, and German, makes up the remaining four-fifths of the book. It contains forty-four full page plates which present one hundred and thirty five x-ray studies, the captions of which, on accompanying pages, are also given in English, French, and German. These plates are reproduced in the negative and are unusually clear, showing the pathology so positively that there is no room left for dispute on these points.

The authors present the problems which have come to them in their study of this subject, approaching these from every angle of difficulty which they have encountered, and striving to elucidate diagnostic methods. This phase of the problem has by no means been solved as yet and the hope is voiced that this publication may stimulate others to do further work.

The chapter on technique gives specific and detailed directions. Special emphasis is laid upon the futility of attempting fluoroscopic diagnosis of these lesions, contrary impressions notwithstanding. The intensifying screen is regarded as indispensible.

About eighteen pages are taken up with expounding interpretation of films. This is dealt with under the heading of direct and indirect evidence. Under the former is discussed the demonstration, classification and differential diagnosis of gall stones. Also under this heading is a section on the visible pathological gall-bladder. The authors regard as very important their discovery that the pathological gall-bladder, even though no stones be present, may cast a shadow, and that when it does cast a shadow pathology is present. This has been adopted as a working hypothesis and experience has proved it to be absolutely reliable. Differential diagnosis of the pathological gall-bladder is given two pages of practical discussion.

Indirect evidence is treated under the heads of deformities, adhesions, organ fixation, spastic changes in the stomach, and changes in the gall ducts.

Statistics are offered, but with a warning as to their well known misleading character at all times.

This is a valuable reference book for the roentgenologist as well as being of interest to other medical men, especially the surgeon. The simple, lucid, practical style in which the valuable subject matter is written, with no wasted words to entangle and weary the hurried reader, might be imitated by many medical writers with profit to their readers at least.

The only criticism offered is that the general make up of the book has added unnecessarily to its expense. The style of print employed makes the book more cumbersome and costly than is practical or than is necessarily consistent with a pleasing appearance.

The Biologic Dosage of X-ray. Francis Carter Wood, M. D., New York City. Med. Rec., March 11, 1922, page 399.

ROENTGEN ray therapy, apparently, is entering upon the phase of exaggerated enthusiasm typical of the history of many therapeutic agents and methods. Absurd claims are being made when a conservative attitude might far better be adopted.

Research at the Crocker Institute has shown that "the rays produced by high voltage are no more potent in killing standard animal tumors than is any other type of x-ray, about five erythema doses being required, no matter what the voltage or the filtration."

The employment of voltages up to 300,000 will offer a distinct advance in effectiveness of method of treatment as soon as x-ray tubes which will run effectively at a voltage of twenty-five thousand or above are built. The technical knowledge required in the successful manipulation of these machines will limit their use to institutions and to highly trained specialists and thereby the theapeusis of malignancy will be largely in the hands of only capable men.

The future of radiotherapy depends upon discovery of the death point for malignant tumors. If five erythema doses are requisite for complete destruction the ultimate conquest of internal cancer is as yet far away.

The writer believes that the recurrence of malignant neoplasms after radiation shows that the effect is largely on the capillaries and mitotic cells and that ultimately such tumors recur from the better nourished peripheral portions where the blood supply sustained the injured tumor cells during radiation. Experiments with animal tumors confirm this opinion.

The dose of the tumor to be treated, the amount which the skin will stand, plus the capacity of the patient to bear a sufficient dosage are factors which should be known in any treatment of an internal malignant tumor.

The usual present method of determining an erythema dose is a cautious cut and try procedure, and though the dosage is finally arrived at, the method is not only time consuming, but every readjustment of machinery results inevitably in slight alterations which make quite a little difference in the output which is not recorded by the milliammeter.

As a basis for standardized procedure the utilization of such a mouse tumor as Crocker Institute No. 180 is advocated, and suggestions are given looking toward a solution of the problem of standardization of radiation methods. Useful data is expected from the investigations of the committee appointed by the American Surgical Association to study the end-results of radiation therapy.

It is remarked that optimism does not cure cancer, neither does criticism of the results of cancer surgery accomplish a cure; publicity, frankness, and co-operation of all concerned, it is hinted, might bring worth while results.

A Case of Extreme Dilation of the Duodenum Due to Chronic Obstruction. R. E. Roberts, M. D., Liverpool. Arch. Radiol. and Electroth., January, 1922, p. 237.

THIS case was diagnosed by the roentgen ray. The patient, a man forty-two years of age, gave a history of abdominal pain and vomiting since early childhood. For a year previous to the roentgen ray examination the patient had had what he called "liver trouble," that is, pain over the liver, loss of appetite, jaundice, flatulence, vomiting and an intractable diarrhea.

The gall-bladder area and the gastro-intestinal tract were examined after a barium meal. No gall stones were found, the stomach and large bowel were found normal, but a very much dilated duodenum was found. At operation this was found to be extreme

indeed. Partial stenosis existed at the juncture of the duodeno-jejunal flexure and about two inches below was a hernial orifice in the mesentery of the jejunum through which almost the entire remainder of the small intestine had passed, but there was no other evidence of obstruction of the small bowel.

The Treatment of Primary Carcinoma of the Vagina with Radium. Leda J. Stacy, M. D., Mayo Clinic. Am. J. Roentgenol., January, 1922, p. 48.

THIS paper was written to call the attention of radiologists to the treatment of primary carcinoma of the vagina by means of radium. The writer found only three cases reported in the literature.

Owing to the rich lymphatic supply of the vaginal mucous membrane the course of this disease is very rapid, terminating in from eight to twenty-six months. It early extends to the iliac glands, but rarely to other organs. The symptoms do not differ from those of carcinoma of the cervix.

From July, 1915, to January, 1921, twenty-one cases were treated at the Mayo Clinic. Information has lately been obtained concerning fourteen of these cases. Seven lived for periods varying from seven to twenty-eight months after treatment and the other seven have been living for periods varying from five months to three years and nine months after the last treatment. Detailed accounts of these fourteen cases are given in the original paper.

The writer believes that radium and x-ray offer better chances for cure than surgery and that as the technique improves a larger number of permanent cures may be looked for; also that better results are obtained with less danger of formation of fistula if the initial treatment by radium is heavy and not repeated, x-ray exposures to the abdomen and back, however, being continued.

Roentgen Ray Stimulation of the Pancreas in Experimental Pancreatic Deficiency. William F. Petersen, M. D. and Clarence C. Saelhof, M. D., University of Illinois, College of Medicine. Am. J. M. Sc., March, 1922, p. 391.

IN the original article the reader is referred to a preliminary communication from the same writers, which was published in the Jour. A. M. A., March 12, 1921. The summary of the article referred to is as follows: "(1) The roentgen ray in proper dosage has the property of stimulating cellular metabolism. (2) When organs are selectively stimulated by the roentgen rays therapeutic results can be achieved either by direct stimulation of an external secretion (the kidney) or of an internal secretion (the pancreas in diabetes). (3) A second method of possibly influencing remote pathologic lesions lies in the mobilization of antibodies, enzymes, and thromboplastic substances following selective organ stimulation. The effects on tuberculosis (irradiation of the spleen), on hemophilia and purpura (irradiation of the spleen), and some of the effects on malignant tissues can possibly be examined from this point of view with profit."

In this preliminary communication, summarized above, two distinct methods of approach were considered. The direct one seeks by stimulation of dys or hypo-functioning organs to attain or restore normal function; examples are found in the treatment of certain types of anuria, hepatic intoxication, amenia, and in endocrine disturbances. The indirect method includes the stimulation of normal organs and the augmentation of serum enzymes, thromboplastic substances, antibodies, etc., thus bringing about therapeutic effects in systemic or local infections.

The investigation of the possible effect which roentgen stimulation of the pancreas might have on the carbohydate tolerance of partially depancreatized dogs was undertaken in view of the admitted limitations in the treatment of diabetes.

An almost complete pancreatectomy was carried out on one animal, which after recovery was placed upon a constant diet of one hundred grams of protein and fifty grams of carbohydrate.

Upon roentgen exposure the sugar excretion for the day of exposure increased from thirty-four to forty-three grams, then diminished for three days and with the fourth day reached approximately its first level. Both acetone and diacetic acid were absent from the urine after the exposure.

In the second dog one gram of pancreatic tissue was left *in situ* and the same diet as above was given. Upon raying this animal there was likewise a preliminary increase in sugar excretion and then, after three days, complete tolerance. The second exposure gave a typical rise, but not so good a final tolerance.

A third dog was partially depancreatectomized and given the same diet as the other two with the addition of one hundred and fifty grams of dextrose on the second day. This dog was given two exposures the same day instead of one. No evidence of increase in the amount of sugar excretion appeared, but a definite diminution in the amount of dextrose eliminated was shown, in spite of an increase in the amount of blood sugar.

Another animal was partially depancreatectomized and a cutaneous injection of turpentine and olive oil given to produce small sterile ulcers. This experiment showed that the mere increase of sugar elimination when brought about by general protoplasmic stimulation does not bring about an increased tolerance.

Further experimentation proved that irradiation of areas other than those containing the pancreatic rests does not increase the carbohydrate tolerance.

In another experiment it was found that the effect of irradiation of the pancreas did not produce merely a transient increase in carbohydrate tolerance but an increase which lasted at least eight days. With increased dosage depression of function and lowered carbohydrate tolerance was noted.

The writers also draw upon Stephan's report of deep roentgenotherapy over the pancreatic area in two cases of severe diabetes.

Their conclusions from this series of experiments they summarize as follows: "In experimental pancreatic deficiency due to partial pancreatectomy roentgen irradiation of the pancreatic rest may be followed by (a) a transient increase in sugar output, then by (b) an increase in carbohydrate tolerance. This latter may occur without the preliminary increase in sugar excretion. The increased tolerance may be transient or may extend over a period of several weeks after irradiation. (c) The increased tolerance is not due to the preliminary increase in sugar elimination. When increased sugar elimination is brought about by some other irritant (turpentine abscesses) no increase in carbohydrate tolerance is later observed. (d) The effect on the blood sugar varies. (e) When evidences of acidosis exist at the time of the irradiation they may diminish or disappear with the improvement of the sugar tolerance. (f) The effect of irradiation on the pancreas is due to direct stimulation of cellular metabolic processes. (g) This stimulation is merely an example of the Arndt-Schulz observation that cell irritants in small doses stimulate metabolic processes. (h) When the irradiation is used in too large a dose injury to the pancreatc function is observed in decreased carbohydrate tolerance. (i) When tissues other than those containing the pancreatic rest are irradiated no effect is observed on the carbohydrate tolerance other than the primary augmentaton of the sugar excretion. (j) The titer of the serum diastases, which may be altered by irradiation of the liver, seems to be without influence on the tolerance.

The Effect of X-rays on Enzyme Action. R. D. Lawrence, M. B., Ch. B. Aberd., King's College Hospital, London. Arch. Radiol. & Electroth., January, 1922, p. 244.

THE literature on this subject is scanty and the results reported are conflicting.

Packard claims that the entire effect of radiation on cells is indirectly due to its influence upon enzyme action. Richter and Gerhartz, studying the effects upon rennin, yeast, pepsin, pancreatin and adrenalin, which latter, the writer observes, is not an enzyme, found either no change or such slight change as fell within the bounds of experimental error. Richards working with pepsin on egg albumin and takadiastase on starch found that exposures (dosage not stated) up to four minutes accelerated enzyme action, above five minutes it slightly inhibited enzyme action and at exactly five minutes there was no change noted.

The writer worked with oxalated venous plasma from men, with urine from a variety of cases, sheep serum, and urine plus horse serum. Radiation was carried out under uniform conditions, the fluid being radiated in a beaker, using a Coolidge tube at nine inches from the anticathode with a five and one-half inch gap and unfiltered radiation at two milliamperes in the secondary.

In no experiment was the diastase found to change after radiation and the conclusion drawn from this series of experiments is that radiation has no effect on enzyme action, as shown by the above method, and therefore the effect, if any, is extremely slight and of no practical importance.

The Treatment of Carcinoma of the Thyroid by the Roentgen Rays and Radium. George E. Pfahler, M. D., Philadelphia, Pa., Am. J. Roentgenol., January, 1922, p. 20.

THE author's experience in treating carcinoma of the thyroid with radium and with the x-rays has extended over a period of eleven years and the results are very gratifying, secured as they were with almost hopeless cases.

The histories and treatment are given for ten cases. One of these when last heard from in 1918 was in good health and had been so during the seven years since treatment. Another case, operated upon by Dr. Deaver, who stated that remnants of the carcinoma had had to be left in the neck, was treated with x-rays and is still well eight years after treatment. A third case operated twice for malignancy, once for bronchial cyst and once for carcinoma of the thyroid, was treated and is still well and free from disease more than three years after discontinuance of treatment. A fourth patient was operated twice for carcinoma in the region of the thyroid. The second time the carcinoma was judged inoperable and was left in place. This case was given x-ray treatment and lived comfortably for about one year, but died two years later from metastases in the spinal column. Two very hopeless cases died, one showed improvement for a year, the other showed none. A seventh case, proven microscopically to be carcinoma of the thyroid, was treated with the x-ray alone and now, nearly three years after treatment, has perfect general health and the hope of a real cure is held out to him. The eighth case treated soon after operation for carcinoma of the thyroid is still well more than two years since operation and post-operative treatment. Still another hopelessly inoperable case was treated first with x-ray and later with radium. He has shown progressive improvement and now, one year and nine months after treatment, carries on his regular duties and hope of complete recovery is held out to him. The last case described had a large tumor, irregular in outline and infiltrated. It was diagnosed as carcinoma, treatment was instituted and two months later all palpable evidence had disappeared and the patient is now, six months since then, apparently well.

Many of these carcinomas were sectioned and upon microscopic examination were pronounced carcinomatous.

The technique is described as follows: "In general I believe that it is advisable to treat these patients through three or more portals of entry, according to the amount and distribution of the disease, with a focal skin distance of thirty centimeters, using a nine inch parallel spark gap, five ma. of current, six mm. of filter, with an exposure of twenty minutes, to be repeated over each area a week apart, if possible, and to treat each area three times, then to stop treatment completely for three or four weeks, when each area can be covered again twice in a similar manner." Radium needles are resorted to if the disease localizes itself to a single nodular mass, which ceases to respond to treatment. "Ten milligrams of radium element in the form of needles can be introduced into the tumor tissue approximately one centimeter apart and left in place six to eight hours, or two centimeters apart and left in place twelve to fifteen hours."

The conclusions drawn are as follows:

(1) Every case of carcinoma of the thyroid that has been operated upon should receive, as soon as possible, at least two thorough courses of roentgen ray treatments, and more if the disease has not been completely removed so far as the surgeon can recognize.

(2) If a diagnosis of carcinoma of the thyroid can be made, without operation, a reasonably good hope of success can be entertained by radiation treatment.

(3) Recurrent cases can be made to respond to treatment and the recurrence can be made to disappear, but the definite metastases are not likely to be controlled in late cases.

(4) Radium can be combined with roentgen ray treatment to good advantage in carcinoma of the thyroid when the tumor has become definitely localized or when it ceases to respond to the roentgen rays.

Treatment of Brain Tumors by Radiation. Henry K. Pancoast, M. D., University of Pennsylvania. Am. J. Roentgenol, January, 1922, p. 42.

BRAIN tumors are as a rule comparatively slow of growth and do not tend to metastasize and are therefore peculiarly adapted to treatment by radiation.

If the growth is localized and accessible it may be exposed and left intact, or it may be partially or completely removed and subsequently treated by radiation or by direct implantation of radium, or by cross firing through the skull. Cross firing holds possibilities in even inaccessible tumors or in those not localizable.

The dangers are comprised under (a) infection caused by radium needles or implanted tumors or infection dependent upon leaving the wound open for the removal of these; (b) the effect upon the flap and upon subsequent healing as a result of external cross fire; this cross fire may be postponed until healing is well under way, however, and since the dosage is a safe skin dosage necrosis of the flap will then be a remote possibility; (c) the effect of radium radiation directly upon normal brain tissue.

This last possibility demands careful consideration. The technique must be based upon the known ability of the normal brain tissues to withstand definite amounts of radiation by implantation or by external cross fire.

Animal experimentation was resorted to to establish these facts. This experimentation was carried out upon dogs at the University of Pennsylvania and the following facts have been thereby established: A dose of nine hundred milligram hours with well filtered radium on the surface of the brain is practically safe, but no dose should exceed eleven hundred and fifty to fourteen hundred milligram hours and might better be well below fourteen

hundred. The safe dosage for implanted tumors is much smaller than the safe surface dose. When actual destruction of normal brain tissue is apt to result the therapeutic dose from implantation must be comparatively small. The well filtered dose may be higher than the unfiltered and tumors act as a filter in protecting the normal tissue.

Because of the great difference in size between the human and the canine head—and because of the comparative safety of the procedure with humans—no animal experimentation was made with external cross fire radiation. Nausea and possible collapse are possibilities to be kept in mind in cross fire treatment and slow procedure is therefore wise.

The technique employed in the treatment of brain tumors is based upon the following factors:

(1) Safe, yet sufficient dosage (based upon clinical and experimental experience).

(2) Implantation contraindicated when removal has taken place, unless a large cavity persists which will permit of the radium being packed in the center.

(3) If the growth has been partially removed, or not removed at all, then the implantation dose depends upon the size of the tumor and its nature—with due regard to the normal brain tissue the destruction of which must be distinctly limited in the brain.

(4) Knowledge of the pathological nature of the tumor is essential.

(5) Dosage for brain tumor is approximately the same as for tumor of same size and nature elsewhere in the body, providing it is not one peculiar to the brain.

(6) Implantation must usually be supplemented by external cross fire.

(7) Cross fire radiation can be repeated with slightly reduced dosage over each area as soon as the skin reaction has subsided.

Cases are grouped as follows: (a) tumors accessible to the surgeon and presumably completely removed; (b) tumors accessible to the surgeon and partially removed; (c) tumors accessible but not removed; (d) tumors not localized or not found at operation; (e) pituitary growths. A general technique is given for each specific group named.

Thirty-two cases have been treated and four considered to have the most important bearing upon this subject are discussed at some length. The writer regards his experience in radiation therapy of brain tumor as very encouraging and full of promise.

Roentgenotherapy of the Thyroid. A. F. Tyler, M. D. Am. J. Roentgenol., January, 1922, p. 25.

ONLY cases of hyperthyroidism are here considered. This includes the typical exopthalmic goiter, the lymphatic toxic goiter and the toxic adenoma.

Roentgen ray therapy of goiter has been in use since 1898 and brilliant results were secured even with the old time methods. The improved technique and methods in use today owe a great deal of their efficiency and usefulness to Pfahler and to Holmes.

The three types of goiter mentioned above are the ones suitable for radiation therapy. Of these three toxic adenoma responds most quickly, next hyperplastic goiter, and last exopthalmic goiter. All other forms should be treated either surgically or by other medical means.

Accurate diagnosis is therefore very necessary and a thorough clinical examination by some one competent is absolutely requisite. First, all family and personal history should be secured. Blood pressure, pulse, temperature and heart should be taken note of and an x-ray examination of all the teeth and accessory sinuses must be made. The tonsils should also be examined for the question of focal infection is an important one in this disease. A fluoroscopic examination of the chest together with plates of the same should be made and lastly a basal metabolism estimation should be secured.

For ambulatory patients the x-ray is employed using ten and one-half inch spark gap, six mm. aluminum and one mm. sole leather, eight inch anode-skin-distance and six ma., giving fifteen minutes over each area (one over each lobe and one over the thymus region). This dosage is repeated in four weeks and three such treatments are usually enough.

Radium therapy is used with hospitalized patients—this to avoid excitement and physical exertion.

Caution must be used in treating severely toxic cases and this is where the metabolic test is invaluable.

There is a close relation between the function of the thyroid and that of the ovaries, and in some cases where the symptoms indicate it, treatment over the ovarian region as well as over the thyroid has brought success.

The importance of the metabolic test as a check is stressed. It must be understood that with roentgenotherapy the basal metabolic rate *gradually* declines to normal in from three to twelve months and no immediate and rapid decline is to be looked for.

With proper technique myxedema is not produced. To avoid producing it and to protect the trachea and larynx the isthmus should be protected from radiation.

The advantages are the avoidance of surgical shock and therefore lessened mortality, and the usefulness of this method when surgery has failed or is impossible.

X-ray in Tuberculosis. R. W. Morse, M. D., Glen Lake Sanatorium, Minneapolis. Journal-Lancet, March 1, 1922, p. 110.

THE x-ray is being used and more in the diagnosis of pulmonary tuberculosis. It should not be looked upon as a rival of other methods of diagnosis, but as an aid. It is a remarkably accurate method and its greatest value lies in negative diagnosis.

Stereoscopic plates are of primary importance in the determination of pulmonary pathology. Fluoroscopy, while it has its place in this diagnosis, is useless in detecting small infiltrations of the lung or in detecting the character of gross lesions.

Breathing during exposure and over-exposure are common faults of technique often leading to wrong diagnosis.

From the standpoint of the roentgenologist there are three types of pulmonary tuberculosis, namely, pulmonary miliary tuberculosis, peribronchial tuberculosis, and parenchymal tuberculosis.

The first type offers little difficulty in diagnosis. It is characterized by the presence throughout both lungs of millet-seed-like infiltration.

The peribronchial type is characterized by linear markings, numerous in number, thickened, fuzzy in outline, nodulated and *extending beyond* a line drawn parallel to the chest wall, which line extends from the junction of the inner and middle thirds of the clavicle to the base—or such markings may extend above the clavicle.

The diagnosis of parenchymal tuberculosis depends upon the involvement of the air vesicles themselves, which form a conglomerate tubercle. The density varies from a slight haziness through cellular infiltration and fibrosis to calcification. This type is nearly always of clinical importance, but peribronchial tuberculosis is not always so.

"Differential diagnosis of pulmonary tuberculosis offers several limitations, and the accuracy of diagnosis will depend entirely upon the experience and judgment of the roentgenologist. Determination of the activity or non-activity of a tuberculous lesion is outside the province of roentgenology.

Purile tuberculosis probably forms a definite entity, but the adult type may occur in the child and vice versa.

The x-ray is of value also in the early diagnosis of ulcerative tuberculous enteritis, tuberculous osteo-arthritis and spondylitis. In the latter lesions it is important to take both the suspected and the normal joints on the same plate for comparison and to avoid differences in technique. Tuberculous osteomyelitis is very hard to differentiate from other infections.

As to therapy, the x-ray treatment of tuberculous adenitis is established as the method of choice. The writer states that his experience is limited as to the therapy of tuberculous skin lesions. He believes that great conservatism should be the rule in advocating or administering x-ray therapy in genital and peritoneal tuberculosis, tuberculous bones, tuberculous enteritis and pulmonary tuberculosis as too little is known thus far to justify any other course.

The Possible Relation of Secretion to Cancer. Elliott C. Prentiss, M. S., M. D., Southern M. J., March, 1922, p. 181.

THIS is a suggestive treatise with deductions drawn from a rather extensive and comparative study of the literature upon gastric and duodenal ulcer and cancer of the digestive tract below the mouth.

The observation is made that cancer of the stomach, crossng into the duodenum, is occasionally benign in the duodenum and that ulcers of the duodenum crossing into the stomach often become malignant there.

The fact that cancer of the stomach seems to grow more slowly after a gastro-enterostomy is regarded as suggestive of the presence of some inhibitory chemical in the collective secretions of the liver, pancreas and duodenum.

Secretion is present in the entire small intestine almost as far as the cecum. It is most concentrated in the duodenum and from there gradually decreases in amount. It is entirely absent in the esophagus, the last two feet of the ileum and the whole of the large intestine.

In support of his views the writer cites the following points: (1) Ulcer of the duodenum is as frequent as ulcer of the stomach, but the same is not true of cancer of the duodenum, and in most cases of cancer of the duodenum the lesion is at the papilla duodenalis and is really not duodenal, but involves the bile duct. (2) Ulcer of the duodenum is apparently not a predisposing factor in the incidence of duodenal cancer. (3) There is some chemical present in duodenal epithelium and not present in gastric epithelium that prevents cancer, or else there is some chemical present in gastric epithelium and absent in duodenal epithelium that predisposes to cancer. (4) This latter substance, if present, is not HCl or pepsin, as the ulcer bearing area of the duodenum is constantly exposed to them. (5) This protecting substance is in the whole of the small intestine, except perhaps the lower end of the ileum. (6) Cancer of the gastro-intestinal tract below the mouth is rare where secretion is present, and relatively common where it is absent. (7) This protecting substance is present in the collective external secretions of the liver, pancreas and duodenum. (8) The liver being the largest secreting gland in the body and infection being so frequent there, we would naturally expect primary cancer in it to be common, but it is rarely found there. Secretin is taken directly to it by the portal circulation and in the greatest possible concentration. (9) The pancreas is a smaller secreting gland than the liver and infection is less frequent, but cancer is more common there. Secretin gets to the pancreas by the general circulation, therefore, in much less concentration. (10) Metastatic carcinoma of the liver is not as frequent as is the total number of cancers in the lower end of the esophagus, stomach, intestines and pancreas. Considering the relation of these organs to the portal circulation this is interesting.

Radium in the Treatment of Uterine Cancer. C. O. Donaldson, M. D. and G. E. Knappenberger, M. D., Kansas City, Mo.

NOWHERE in the field of radiology are the results more encouraging than in the treatment of uterine cancer, though the writers disagree with those who would exclude surgery from this field.

Within the last two years and one-half sixty-two cases of cancer of the uterus have been treated with radium by the authors of this paper. Eleven of these were post-surgically treated, the others were inoperable cases. Only five of the entire number were early, localized, or operable and these five are alive and well at the present time. Of the others, ten are dead, ten are lost track of, fifteen are clinically well, twelve have developed recurrence or metastases, and ten are still under treatment.

Biopsy was at first employed, but is now regarded as unwise. Trauma from the placing of radium is also most carefully avoided.

All operable cases, the writers believe, should have pre-operative radium and x-ray treatment to minimize the danger of trauma at operation, and to utilize the uterus as a filter. Also in using radium it is easier to protect the bladder and rectum before a panhysterectomy than afterwards.

As for palliation in doomed cases radium has no equal. Clinical recovery in some of these extreme cases has extended to eighteen months, but its permanency is not hoped for.

Fifty milligrams of radium element, screened with 0.5 mm. silver and one mm. of brass, usually with a heavy rubber tube over the brass capsule, is inserted into the cervical canal. Sometimes twenty-five milligrams of radium element is inserted in this way and twenty-five more placed across the cervix with a "T" applicator. Usually three to four twenty-four hour treatments with a twenty-four hour interval between them are given. The extent of the disease, the size of the vagina, and the patient's ability to take treatment are governing factors in the treatment. Thirty-five hundred to four thousand milligram hours per week is the usual amount given.

After the pack is removed the patient is allowed to be out of bed, largely for the psychological effect. Close observation is made for two weeks following the treatment and x-ray therapy begins as soon as any constitutional reaction is gone. Routine examination is made every two months.

diagnosis.

The writers stress the responsible role of the general practitioner in early

The Treatment of Malignant Neoplasms of the Tonsil. Douglas Quick, M. D., New York City. J. Radiol., May, 1922.

NEOPLASMS of the tonsil are usually noted early and often receive the wrong type of treatment for lack of proper diagnosis. Lymphosarcoma is the most common neoplasm in the young, and because of its many atypical forms, is often reported as some other variety.

Matthews in an extended report (1912) did not regard surgery with favor. On the use of roentgen ray and radium there are but few reports, so that statistics are not available.

Janeway's method of radium emanation buried interstitially has been in use at the Memorial Hospital for the past five years and has proven of inestimable value.

The treatment of all intra-oral carcinoma is divided into two stages—treatment of the primary growth and that of the cervical nodes. All primary lesions, the author believes, should be treated by radium alone. Treatment in all cases should be based upon the prognosis—some cases may be given only palliative treatment and some must be temporarily relieved through medicinal means.

Complete regression from a single dose should be the aim both from the point of the patient's interest and the ease of treatment. For palliation smaller amounts oftener applied are used. Dosage and technique are given in detail.

The treatment of cervical nodes consists of a combined treatment of radiation and conservative surgery, however, surgery plays no part in the treatment of cervical extensions of lymphosarcoma or malignant granulomas.

One hundred and forty-nine cases of malignant neoplasm of the tonsil have been treated at the Memorial Hospital during the past five years. Mistakes of treatment are acknowledged in many cases, but favorable results were secured in many others.

The conclusions drawn are as follows: (1) In all malignant neoplasms of the tonsil radium is the agent of choice for treatment of the primary growth. (2) Best results can only be obtained in these cases by interstitial radiation—either by means of radium emanation or lightly filtered needles containing radium element embedded in the growth. This should be supplemented by heavily filtered external radiation—either x-rays or radium. (3) The treatment of cervical metastases of carcinoma of the tonsil is best managed by a combination of radium, x-ray and conservative surgery. (4) In lymphosarcoma or the malignant granulomas of the tonsil, surgery plays no part. Metastases to the cervical nodes or elsewhere should be managed entirely by a combination of radium and x-rays. (5) Experience encourages continuation of treatment along these lines.

Three Cases of Sarcoma Treated by Radiation. D. Y. Keith, M. D. and J. P. Keith, M. D., Louisville, Ky. Am. J. Roentgenol., January, 1922, p. 31.

THREE very unusual cases are here reported. The first case had had a small pigmented tumor, located in the suprasternal notch, removed by surgery. Recurrence took place one year after operation and the growth was again removed and again recurred, this time within three months. The surgeon stated that at the last operation it had been impossible for him to remove all of the pigmentation. At the time roentgen ray treatment was begun there was present deep in the episternal depression, a black mass the size of a navy bean, spongy upon palpation and jelly-like in appearance. Six months after treatment was begun complete regression had taken place, and now, more than five years later, there is no evidence of return. Treatment was continued at regular intervals up until December, 1920.

The second case had been operated twice for a growth in the left side of the neck, and had been operated a third time to remove several enlarged glands lying just over the carotid artery. Eighteen months later the enlarged nodules had again been removed and the pathologist's report was "malignant tumor rapidly growing—possibly metastasizing from a tumor in the central nervous system" and in addition he asked the privilege of post mortem study in the event of fatality. Five months later another operation was performed and a diagnosis of melanotic sarcoma, metastatic, was made. Several nodules the size of shelled peanuts made their appearance after this operation, and four months from the time of the operation x-ray therapy was instituted. Within sixty days the nodules had disappeared and the patient is now well and free from recurrence, thirty-three months since the date of the first treatment.

The third case was a patient who had developed swelling and pain in the right pectoral muscle following upon violent exertion. She had been treated for pneumonia with no relief, and upon presenting herself to the radiologist there was marked edema of the arm and hand, marked glandular enlargement of the axilla, together with a tumor the size of an orange in the upper half of the mammary gland, with such induration that it was not possible to say at the time whether the tumor was in the gland or in the pectoral muscle. Roentgen ray therapy relieved the pain within a week. The edema completely disappeared and at the present time, fifteen months since treatment was begun, there is no evidence of tumor anywhere. Two months after treatment was instituted the patient insisted that she was well and wished to discontinue treatment, but she was persuaded not to do so, and at present is under orders to report at regular intervals of three months for the next two years.

Fractures of the Carpal Scaphoid. Albert M. Pfeffer, M. D., Baltimore, Md. J. Radiol, May, 1922.

FRACTURES of the carpal scaphoid are a clinical entity, so recognized since the advent of the x-ray. So-called sprains are often fractures of this type and escape detection at the time of occurrence.

These fractures are usually the result of violence, falls or accidents, such, for example, as occur in cranking a motor.

Because of its position in the skeletal structure the carpal scaphoid is more apt to be injured in these accidents than either the os magnum or the radius. There are three types of its fracture; the greatest number of these are the simple transverse type, the second type is the transverse type with impaction of fragments, and the third type is a fracture of the tuberosity. The general tendency of these fractures is to remain ununited. They are apt to be complicated.

It is often from two months to two years after the fracture before the symptoms of weakness or pain in the wrist demand attention. There is usually found a history of "sprain" or perhaps of Colles' fracture. The early symptom is swelling, often appearing almost instantly after accident; it is limited to the radial side. Upon palpation severe pain is found immediately over the scaphoid. The Vaughan knuckle percussion test is a reliable sign. Changes in measurement from the radial styloid to the end of the second metacarpal bone is disputed as is wasting also. Ecchynosis is absent, and crepitus also, as a rule.

Inexperienced x-ray diagnosis is apt to be misleading because of the peculiar shape and position of the carpal scaphoid. The technique must be precise. Plates must be made at different angles and in different positions, and in doubtful cases it is well to employ the fluoroscope because this allows of observation during movement from the supinated to the pronated position, during which a fracture will be detected which otherwise would escape detection. Stereoscopic views should be employed. Diagnosis can in many cases be made from history and clinical findings alone, but a radiogram and fluoroscopy are decisive.

There are possibilities of variation from the normal in the scaphoid bones and these variations must be considered. Some scaphoids consist normally of two or three parts.

Diagnosis of Pulmonary Conditions in Children. John W. Pierson, M. D., Baltimore, Md. Am. J. Roentgenol. January, 1922, page 11.

A SERIES of children ranging in age from one day to eighteen months were examined for the purpose of determining how early the markings, so familiar at the roots of adult lungs, are found in children.

Tiny circular shadows (two or three millimeters) were found at the ends of the major divisions of the bronchi, as early as the first day. These became more clearly defined as time went on and were heavier in children who had had pulmonary infections. The conclusion from the study is that certain minor changes must be expected in the lungs of all children. As to how far

these changes may go before being considered pathological has not yet been determined, but this is being investigated.

In the writer's clinic eighty children were examined and forty-eight showed changes which were diagnosed by the x-ray as pathological, but the physical tests gave only fifteen. The author considers that the x-ray diagnosis was far too critical in this series and he states that there are many factors which cause changes in the lung picture and which at the same time have no bearing upon the case.

Acute bronchitis can not be demonstrated by the x-ray, but lobar pneumonia is very easy to demonstrate. The latter when it has cleared leaves no markings, but broncho-pneumonia leaves markings which remain for a long time. This latter lesion in its acute stage is characterized by areas of consolidation of varying size with indefinite outlines. These are usually found at the base of the lung, but they may be anywhere. They are sometimes impossible to differentiate from consolidations of tuberculosis, especially if the chronic stage of bronchopneumonia has been reached. Both tuberculosis and bronchopneumonia cause fibrosis.

Tuberculous lesions in children are not always found in the upper lung, as is usually the case with adults, but may be found anywhere. As the child grows older the characteristic fan-shaped lesions appear. There is one sign which is regarded as being almost pathognomonic of tuberculosis and that is the enlargement of the mediastinal glands, but the writers insist throughout that the x-ray findings alone must not be relied upon, but must be considered in conjunction with other findings.

Some Points in the Physics and Technique of Roentgen Ray Work. A. L. Gray, M. D., Richmond, Va. Southern M. J., March, 1922, p. 185.

A MINIMUM of apparatus for necessary work should be the rule.

In a hospital having fifty to one hundred beds the roentgen ray department should have an operating room which can be darkened and which is of sufficient size to admit a wheel stretcher and table. There should be an adjoining room with the wall toward the operating room lead lined and containing a leaded glass window with the lead overlapping the glass on all sides. This room may contain the generator and control switches and may also serve as a demonstrating room and may serve for storage of plate files and records. A third room is necessary for a dark room, which should be conveniently located to and amply protected from the operating room.

The transformer need not have autotransformer control, but should have a sufficient capacity to pass sixty milliamperes through a tube backing a six inch parallel gap. A combination stereoscopic and fluoroscopic table which can be put up vertically or horizontally and also tipped at various angles, at will, is necessary. Wire or brass tubing may be used for the aerial trolley system. Connections, fastenings and insulations must all be carefully and frequently inspected.

The large type of transformer must not be operated in the same room where fluoroscopic observations are made and the auto-control of a transformer should never be utilized in a darkened room.

The meters (usually accompanying the transformer), a Coolidge transformer and meter and a portable control, a stereoscope, protecting apron and gloves complete the necessary equipment for the operating room. For the dark room will be necessary a small six-compartment soapstone tank, or else two steel tanks in a galvanized iron or stone tank, a thermometer, a dark room light, plate racks and developing frames for films and plates and a pair of intensifying screens of each of the following sizes: 14x17, 11x14, 10x12 and 8x10.

Methods of identifying the plates, of taking stereoscopic chests and head plates and of differentiating a calculus in the kidney from one in the gall-bladder are given. An apparent filling defect in the fundic or antral portion of the stomach often disappears when a four inch sand bag is placed under the patient's thighs so that the weight of the body rests upon the chest and thighs and the stomach becomes distended.

A Review of the Course and Treatment of Carcinoma Uteri. By A. Norman McArthur, M.B., B.S., M.R.C.S., L.R.C.P., St. Vincent's Hospital, Melbourne, Australia. The M. J. Australia, February 11, 1922, p. 145.

THE data for this paper has not been secured from the literature, but from the author's extensive experience.

To his mind there are but two methods of treatment, surgery and radium, and all others are worse than useless.

Some rather unflattering observations are made upon the "lack of diagnostic acumen" displayed by the general practitioner. The writer takes occasion to ask if this seeming carelessness may not be due to the so-called contract practice in which the overworked and underpaid general practitioner looses initiative and becomes callous to symptoms. The specialist also comes in for a share of rebuke. The writer charges that many, many cases might be saved a fatal termination were it not for this seeming ignorance or else carelessness in regard to important early symptoms.

He makes it very emphatic that there is no age limit, citing three cases in his own experience under twenty-seven years of age and quite a number under thirty-five. Cachexia is not present in all cases by any means. Hemorrhage is a dangerous symptom too often passed by and pain is a symptom of the later and hopeless stage of this disease.

The Wertheim panhysterectomy is the surgical procedure preferred by this writer. He uses this with a slight modification. Vaginal hysterectomy he states may be useful in early cancer of the uterus, but at no other time.

Recurrence has always been the surgeon's great problem, but in the latter years the roentgen rays and radium have come to his aid. The use of radium is favored rather than the roentgen rays because of the exacting technique for these and because of the fact that they are less penetrating than the radium.

Radium renders many an apparently hopelessly inoperable case operable. It reduces pain, checks bleeding and diminishes offensive odor, reduces inflammatory thickening and sterilizes outlying cancer cells. Contrary to finding connective tissue developed by the use of radium this writer finds that radium seems to gelatinize any connective tissue with which it has come in contact and renders operation less difficult. Radium, he states, "is the greatest ally the surgeon has ever had in these dreadful cases."

The Superficial Reaction of Radium as a Guide to Dosage. William S. Newcomet, M. D., Philadelphia. Am. J. Roentgenol., January, 1922 p. 34.

THE more flexible the radium unit the better will be the results. Several small units are preferable to one larger one.

Sometimes local abatement in one area and progressive growth in another occurs. It is then best to stop all treatment for several months, when treatment may again be resumed.

The reaction from radium, while not generally considered as dangerous as that from x-ray, will give practically the same results under similar circumstances, and any modification is due rather to a difference in application than to a difference in radiation. The ery-

thema dose is the standard with the roentgen ray and is worked out by the factors of distance from the anode, strength of current, etc. With radium the results depend upon the amount of radium element, distribution of radiating material, time of application, duration and intervals, distance from the part, style of container and kind of filters.

Any modification of these factors will produce a difference of result, namely, one hundred milligram hours may produce quite different effects, according to the amount of radium element and the proportionate time employed. Expression of dosage by milligram hours alone is a fallacy which the writer goes into some detail to prove. If the beta radiation is not removed the surface radiation will be then so great that a comparatively small dosage will cause superficial ulceration. Time as a factor must be considered according to the area covered and also in connection with the areas in the immediate vicinity.

The character of the tissue must always be considered, especially if previous irritation from other sources has existed. Late reactions and ulcerations have sometimes been caused by irritants applied after radiation.

In pathological structures the variation is far wider than it is in normalcy.

These factors and features are all elaborated upon in relation to the theme of this paper. The author states that there is no pretense of entering into any scientific detail as to exact measurements, nor of entering upon any microscopical study of tissues in various stages, but that this article is based upon a large number of applications to prove some facts which were observed in the ordinary treatment of a large number of cases.

A Comparison of Radiation Dosages Attainable by Use of Radium on and Within Tumors. Charles H. Viol, Ph. D., Pittsburgh. Am. J. Roentgenol., January, 1922, p. 56.

THE points brought out by Friedrich and Kroenig in regard to increased radiation dependent upon secondary radiation are interesting and important, however, the fact remains that clinical results must remain the measure of value of any method and of any technique.

For deep x-ray treatments massive doses are required and the limiting factor is usually the tolerance of the skin When massive doses are employed bad systemic results follow even when the harder rays are used.

Radium, however, may be brought [illegible] even a deeply seated growth and radium emanation has been implanted in tumors since 1914. Metal radium needles containing radium salt have also been employed and found satisfactory.

"The immediate problem in radiotherapeutic treatment of a localized malignant growth is to secure an adequate or lethal dose of rays in the farthest outlying cells."

The intensity of the rays from a small source varies inversely as the square of the distance from the source, and if the distance between the radium and the farthest outlying cells is reduced to one-half the first distance (by insertion into the tumor mass) the ray dose will therefore be increased four times. This gives the nearest approximation to homogeneous radiation, secures the most intense effects of radiation within the tumor, and avoids the waste resulting from cross fire, together with the possible undesirable effects therefrom upon adjacent normal tissue.

The writer believes that the only hope of successful radiotherapy in malignancy of the bladder, prostate, and stomach lies in a method by which the radioactive substance will be placed throughout the mass of neoplastic tissue.

The possibility of enhancing the action of x and gamma rays by means of radiators, such as implanted metal needles, injected colloidal metals or salts is discussed. The writer believes that the support of this view is not logically founded and quotes experimentation by Frederich and Binder in support of his attitude. These workers found the radiation intensity to be less with radiators than without them.

Radiotherapy in Carcinoma of the Breast. George E. Pfahler, M. D., Philadelphia. Abstracted in Bost. M. & S. J., March 9, 1922, p. 318. Read before the Suffolk District Medical Society, Massachusetts, January 25, 1922.

RADIOTHERAPY in carcinoma of the breast can be divided into three parts:

(1) Ante-operative and post-operative treatment. In this group of cases there should be a conference between the radiologist and the surgeon before deciding upon any course. Ante-operative treatment is justified by both theory and experimental investigation. This treatment requires approximately two weeks, at the end of which time the patient can be operated upon. Post-operative treatment should begin approximately two weeks after the operation has taken place and will take an additional two weeks of treatment. Unless the disease is very far advanced the patient is then observed once a month for a period, and later on, at longer intervals.

(2) Recurrent and metastatic cases always give unfavorable prognoses, but sometimes brilliant results can be obtained. The most thorough radiation possible should be given to the local recurrences and the local metastases, but the general area likely to be involved by metastases should be included in treatment. In all primary operative, and recurrent cases of cancer of the breast, a roentgenogram of the chest should be made. Radium can sometimes be used to advantage with the x-ray in controlling recurrences and metastases.

(3) Primary carcinoma of the breast has been studied mostly in the inoperable and more or less hopeless cases. Some of these have shown remarkable response to treatment, and occasionally an inoperable case can be made operable. In primary cases it is advisable to treat the patient over the carcinoma and the general glandular distribution throughly with the x-rays first, and then follow with radium introduced directly into the tumor mass at about the time that we would otherwise do an operation. Close co-operation between the surgeon and the radiologist will produce better results than can be obtained in any other way.

X-ray Treatment of Carcinoma of the Breast. Arthur W. Erskine, M. D., Cedar Rapids, Ia. Illinois M. J., March, 1922, p. 209.

WHETHER intensive radiation should be employed in addition to surgery in treating these cases must be judged from the results already obtained. The rays have been used in these cases for the last twenty-five years and the results obtained throughout these years, and especially those obtained with the use of modern methods, furnishes abundant justification for continued treatment of such cases.

These results make it reasonable to expect from the present ordinary intensive radiation a twenty-five per cent increase in the number of patients alive five years after operation. Also it is reasonable to expect prevention of ulceration and breaking down of the tumor, destruction of superficial metastases. prolongation of comfortable life and finally an easy death.

In regard to operability two opposite views are held by radiotherapists. One group holds that the presence of metastases renders the cancer inoperable and that here x-rays and radium are the best means to employ. The second group holds that the intensive use of x-rays has widened the field of operability and that whenever the primary

tumor can be removed with a reasonable expectation of the skin closing that the operation should be performed. This latter is the author's view.

Since metastases may be present in any part of the chest, routine post-operative x-ray treatment should be the same in all cases, regardless, and the dosage should be large enough to inhibit the growth of cancer cells.

Attack is made from four directions at a distance of sixteen inches; copper filters, the equivalent of ten mm. of aluminum, one hundred thousand R. M. S. voltage, five ma. passing through the tube, are the points in the author's technique. He states that whether to attempt a lethal dose at one sitting is a question which calls for courage in its solution.

Errors in the Roentgenologic Diagnosis of Duodenal Ulcer. Russell D. Carman, M. D., Rochester, Minn. I. Radiol, May, 1922.

ROENTGENOLOGIC diagnosis of duodenal ulcer is today easily accomplished and the percentage of error is slight.

The only trustworthy indications in this diagnosis are deformity of the duodenal contour and the combination of retention and hyperperistalsis in a large but otherwise normal stomach.

The causes of error may be affirmative or negative. The former may be due to faulty technique or examination, or confusion of pathological identities, or may be due to over-emphasis of some minor point not in itself indicative of this lesion. The negative errors may be due to faulty technique, ignoring the duodenum in case of other pathology, unfavorable position of the duodenal bulb and actual or apparent absence of bulbar deformity. All these sources of error are discussed in the original paper.

In a series of cases covering the year ending June 30, 1921, out of five hundred and twenty-two cases diagnosed as duodenal ulcer four hundred and ninety-nine were proven at operation. The writer is hopeful that the small percentage of mistakes in diagnosis will be still further reduced. He does not believe that clinical facts should be employed by the roentgenologist in making his diagnosis, as this has been found to lead to mistakes.

The author's conclusions may be found at the close of the paper published in the scientific section of this number of the Journal.

Notes on Twenty Cases of Ulcer of the Leg. Treated by Electrical Methods. C. A. Robinson. M. B., D. M. R. E., West Middlesex Hospital, St. Bartholomew's Hospital, London. Arch. Radiol. & Electroth., January, 1922, p. 253.

THOUGH one of these cases was syphilitic, the principal factor of causation in all others seemed to be a stagnation or congestion in the circulation of the legs. The underlying constitutional cause is believed to have been a deficiency in ionized calcium and other metals in the blood, due perhaps to deranged endocrinal function. Also in many cases scarring had left the ulcer deprived of its vascular supply. Not one case had well marked varicose veins, but the feet and lower legs were cold, subjectively and objectively, and were cyanosed.

To increase the amount of blood flowing through the surrounding tissues a direct current with the cathode applied to the ulcer was employed. This removed crusts and scabs and allowed free discharge of pus. Phagocytosis was thereby increased and all the processes of natural defense quickened.

Of the twenty cases, four were definitely successful within two weeks to two months, five are healing rapidly at present. Four were definite failures. Seven are regarded as inconclusive because five of these were treated less than eight days, one case was of twenty years duration and one was found to be syphilitic and healed rapidly upon an injection of novarsenobenzol.

Some Practical Applications of Ionization Measurements of X-rays. Arthur W. Erskine, M. D., J. Radiol., May, 1922.

THE conclusions drawn in this paper are based upon the three assumptions that Dessauer's theory of homogeneous radiation is correct, that the ionizing effect and the physiological effect of x-rays are somewhere near the same, and that the absorption power and scattering rate of x-rays in water approximates the rate in human tissue.

Assuming that the action of x-rays on deep seated tissue is purely destructive, the problem in deep therapy is to deliver a sufficiently large dose to deep structures without injury to the skin.

Experiments carried out verified the belief that increasing the voltage, size of fields, anode-surface distance and thickness of filter increased the percentage of radiation delivered to the depth; not only this, but there seemed to be a definite mathematical relation between the four factors.

Various changes in the factors of technique were experimented with to determine the effect upon the ratio between the surface and depth dose. These experiments are fully described and data given with accompanying plots and graphs.

From these experiments the writer concludes that increased voltage lowers the surface depth ratio and lessens the time required for administration of a given dose, the capacity of the apparatus being the limit of desirable increase in voltage; the intensity being nearly uniform the entire beam may be used; the field should be at least fifteen cm. square; anode-skin-distance should be just great enough to allow the entire surface to be treated at one time, the limit of economical increase being usually between fifty and sixty cm. for anode-skin distance; for filter thickness this limit is dependent upon the voltage employed, about 0.4 mm. Cu for 130 to 140 kv. and about .75 mm. Cu for 200 to 220 kv.

Studies on X-ray Effects. The Action of Serum From X-rayed Animals on Lymphoid Cells in Vitro. James B. Murphy, M. D., J. Heng Liu, M. D., and Ernest Sturm. *From the Laboratories of The Rockefeller Institute for Medical Research.* J. Exper. Med., March, 1922, p. 373.

HEALTHY young rats were exposed to the x-rays, using the following technique: spark gap, two and one-half inches; ten ma.; distance, twelve inches; time, fourteen minutes. Animals were immediately anesthetized and exsanguinated.

"Aproximately fifty-seven per cent is absorbed by the first one-fourth centimeter of tissue, and more than ninety-two per cent before the rays have penetrated to the depth of one-half centimeter, while at a depth of one and one-half centimeters only 0.56 per cent of the rays remains." It is thought doubtful whether these rays penetrate to the deeper lymphoid organs sufficiently to cause changes, though these organs show as much evidence of stimulation as do the superficial ones: which is suggestive that the spleen and lymph gland changes may be secondary to some alteration, caused by the x-rays, in the circulatory blood or other tissue.

This experiment failed to show any evidence of so-called lymphotoxin in the series of x-rayed animals, even after an exposure so long as to cause almost complete destruction of the living lymphoid tissue.

The following conclusions are drawn:

"Lymphoid cells, prepared from the thymus and lymph glands of rats, when suspended in the serum of x-rayed rats and incubated for two hours, increase in number from fifteen to thirty per cent, and mitotic figures are found among these cells in fairly large numbers. A like suspension of cells in normal serum undergoes rapid disintegration and in only one instance

among a large number of films examined was a mitotic figure found.

"The stimulative effect of the serum from x-rayed rats endures from one to two hours after the exposure, but is not detectable in the serum taken seventeen hours or later after the treatment. Serum rayed *in vitro* is devoid of stimulative action.

"The lymphoid cells of rabbits and guinea pigs are so fragile as to make impossible the obtaining of counts accurate enough for experimental purposes. The serum of one species caused such rapid disintegration of the cells of another that it was impossible to determine the specificity of the reaction."

The Principles of Electrotherapy and Their Practical Application. By W. J. Turrell, M. D., 1922. 8 vo. pp. 288. Oxford University Press, 35 West 32nd St., New York City. $3.85.

THIS book contains twenty-nine splendidly clear illustrations. It is written in a simple, direct, almost narrative style. The bibliography is arranged at the end of different chapters.

The book is divided into four parts: (1) The Therapeutic Action of Current Electricity. (2) The Therapeutic Action of Radiant Energy. (3) Electro-Diagnosis. (4) An Outline of the Application and of the Mode of Action of Electricity in Certain Diseased Conditions.

For about ninety pages the subject of the therapeutic action of electricity is discussed under the sub-heads of the constant current, interrupted currents of low frequency, interrupted currents of high frequency and currents derived from the static machine. The author does not "beg the question" of the therapeutic action of the constant current by merely saying that its beneficial effects are due to ionic interchange which takes place in the tissues, but handles it in detailed fashion, bringing laboratory experiments and data from his own personal, practical experience to bear upon it. In like manner the other subheads are taken up. He himself has designed an instrument, electrically driven, for the surging of therapeutic currents of low frequency. He pays tribute to the Bristow coil, which he says is superior for obtaining the very valuable graduated contractions by the Bristow method and adds, "in fact I do not think any mechanically operated instrument can replace the personal factor of the operator, which is so essential a part of Mr. Rowley Bristow's method."

In the chapter on high frequency currents is an explanation of a method, termed "Indirect Surgical Diathermy," for removing minor blemishes of the skin and introduced by the author himself. The patient being charged from a diathermy apparatus with about five hundred milliamperes the operator applies to the part to be destroyed a pointed metal instrument to which no wires are attached. The current with which the patient is charged is attracted to the base of the growth and inductively attracts to the surface of the growth a similar current from the capacity of the operator. This oscillates over a million times a second, so that the destructive process operates almost simultaneously on the surface and at the base of the growth.

In the second division of the book is discussed radiant heat and light, ultra violet radiation, and x-rays. Here the author differs somewhat from some American scientists in the explanation of the therapeutic action of the x-rays. His opinion is that the more rational view of "the therapeutic action of the x-rays is to regard them as an intensified form of the action of the ultra violet radiation," which action is regarded "as due to the oxidation or reduction in the tissues resulting from the changes in valence produced by the electronic discharge caused by the resonant agitation excited in the cells by radiation."

Part three explains electro-diagnosis of peripheral nerve lesions and nervous and other diseases. The special value of the electrical tests is that they afford objective evidence in place of the subjective signs afforded by the other methods of observation. Aside from two very rare, almost negligible exceptions, a faradic current causes muscular contraction if there is an organic nerve lesion. In diagnosing diseases there may be faradic hyper-excitability or hypo-excitability, galvanic hyper-excitability or hypo-excitability, or complete inexcitability. As a general rule where the tendon reflexes are increased, both galvanic and faradic hyper-excitability will be found.

Part four is by far the largest of the four divisions of the book. It deals with the application and mode of action of electricity in certain diseased conditions, and as a surgical agent. It is written in an explanatory and almost prescriptionary style, illustrated with cases, many of which the author has personally handled. An interesting example is that of a late war case of severe causalgia in a man having a wound of the right forearm, upon whom weak galvanic currents rapidly interrupted by a Leduc interrupter worked a most happy recovery, as far as the pain was concerned.

A Study of Renal Function in Roentgen Ray Intoxication. Resistance of Renal Epithelium to Direct Radiation. Irvine McQuarrie, M. D. and G. H. Whipple, M. D. *From the Hooper Foundation for Medical Research, San Francisco.* J. Exper. Med. Feb., 1922, p. 225.

NORMAL adult dogs were used in this study. Exposures were made with the hard roentgen rays of the Coolidge tube, the softer rays filtered out with two mm. aluminum. All exposures were percutaneous and the distance from target to surface was twenty-five cm. in each case. Eight ma. were used in most experiments though as high as ten and as low as five were used in some. A nine inch spark gap with an e.m.f. of about ninety kv. was used with few exceptions.

In part of the experiments moderate doses were given with rest intervals extending over a considerable period of time. Huge doses were given either singly or successively. Different body regions were exposed separately in the various experiments. Dogs were given only water three days preceding and five to six days following exposure. During rest periods they received the usual mixed diet.

The phenolsulfonephthalein elimination test was used to measure the kidney function. Daily determination of blood urea was made in all cases and the ratio of one hour's urine *to* urea per one hundred cc. of blood was determined in many cases.

The author's conclusions follow:

"Our experiments give no support to the current belief that an x-ray nephritis may be produced by direct or indirect action of the hard roentgen rays.

"Moderate doses of x-rays given repeatedly over considerable periods of time have no demonstrable influence on renal function or renal structure.

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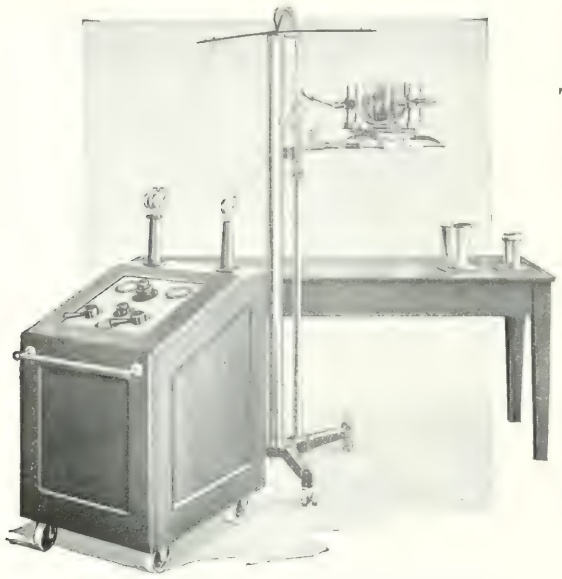

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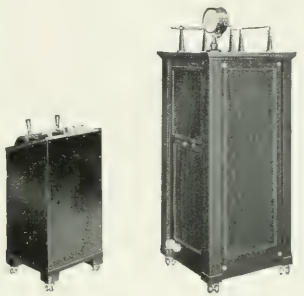

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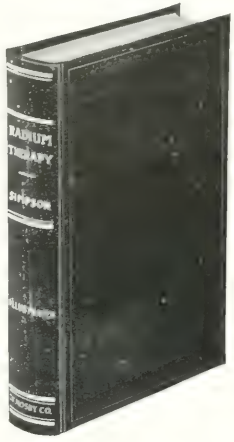

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7—Absorption of Gamma Rays in Water.
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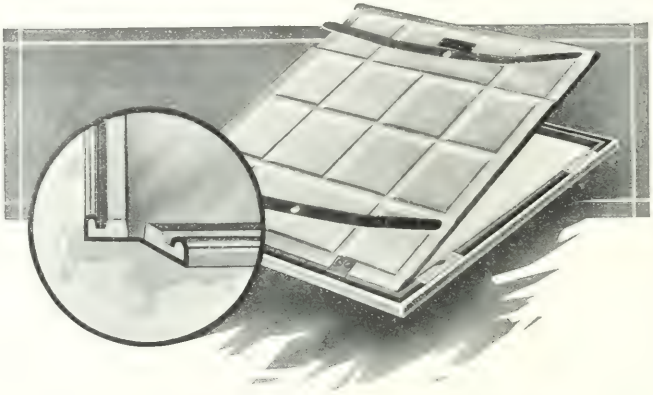

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Cast aluminum cover, reinforced with ribs which carry the weight of patient when necessary; also lends strength to the cover.

Felt pad, backed with sheet lead to cut off any possible secondary radiation from reaching the back of screens.

Spring pressure applied to four points of the cover; thereby rendering even and vigorous contact over the entire surface of the front,

Non-friction flexible hinge, which prevents the screens from grinding together when opening and closing the cassette.

Made of nickeled steel and aluminum; only one-half inch in thickness; no felt strips to come loose.

LIGHT WEIGHT
STRENGTH WHERE STRENGTH IS REQUIRED.
PRESSURE WHERE PRESSURE IS NEEDED.

BX-OC

BUCK X-OGRAPH CO.

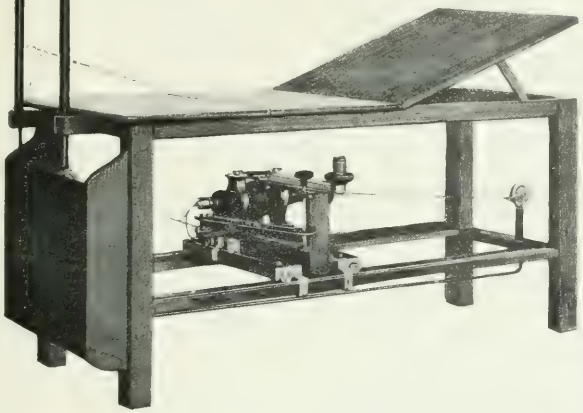
ST. LOUIS, MO.

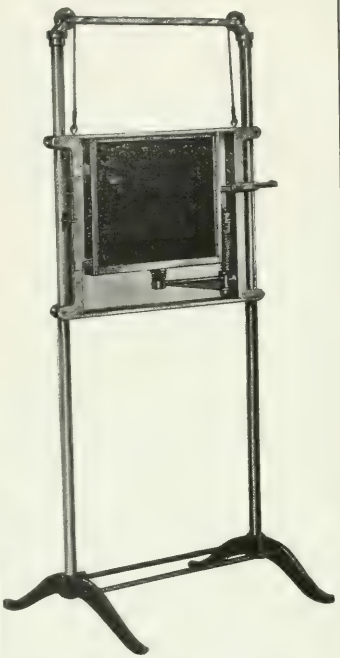
The Solace Stereoscopic Plate Changer

This is a device for presenting to the X-Ray in easy and rapid succession, two plates or films as is necessary in radio-stereoscopy.

The apparatus is loaded with the two plates, the patient is posed, and the shift of plates is made, when you are ready by no other effort than a slight pull at the release.

It is adjustable to the height of the patient or the part of which a stereoscopic-radiograph is desired, and is rigid enough to steady the patient during the exposure.





The Solace Hospital Fluoroscopic Table

This very popular apparatus embodies unusual convenience and protective features. The control of the milliamperage, the size and shape of area of patient exposed to the X-Ray, are under the control of the operator during observation.

Requests for further information solicited.

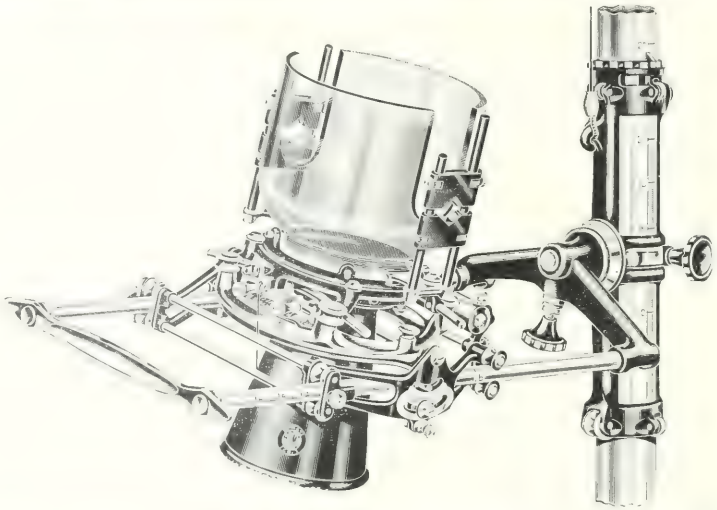
Waite & Bartlett Manufacturing Company

Factory and Main Office
53 Jackson Avenue, Long Island City, New York

New York Office — 103 Park Ave., New York City
Austin, Texas (Oliver Brush) — 708 Colorado Street
Boston, Mass. (Clapp-Anderson Co.) — 18 Boylston Place
Mexico City (Aztec Electric Co.) — Apartado No. 1300 la de Bucareli, No. 24, Mexico, D. F.
Tampico (J. B. LaRiviere) — Apartado No. 217
Monterrey (L. M. Carranza) — Apartado No 316, 5 de Mayo 172
Melbourne, Australia (Stanford X-Ray & Radium Co.) — 218 Russell Street

A RADICAL IMPROVEMENT IN TUBE STANDS

Acme No. 1 Radiographic and Stereoscopic Tube Stand



Tube Head and Carriage of Acme No. 1 Tube Stand

True stereoscopic image with any exposure distance from 18 to 36 inches.
All stereoscopic adjustments, including the air control for vertical work, contained within the tube head.
Stereoscopic Mechanism, on ball bearing rollers, operates with perfect ease in any position.
Radiographic and stereoscopic work from any angle or position and either horizontal or vertical.
Friction joints and plunger stops replacing old method of hand lock screws.
Tube swivels around a complete circle.
Four accurate scales giving all necessary measurements at a glance.
Full ball bearing.
Tube carriage counterweighted, cable used being flexible aircraft cable, having highest tensile strength.
Tripod base equipped with easily rolling casters and floor locks.
Finish—Black enamel and polished nickel of the usual Acme quality.

ACME PRODUCTS ARE ABREAST OF THE TIMES

Illustrated descriptive bulletin furnished upon request

ACME X-RAY CO.

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Distributors in all principal cities

INTENSIFYING X-RAY SCREENS

Equal to any intensifying screen for plate or film work on the market.
Your money refunded if not entirely satisfactory or as represented.

SIZE	SINGLE		DOUBLE	
	WASHABLE	CLEANABLE	WASHABLE	CLEANABLE
8 x 10	$ 8.00	$ 7.50	$16.00	$15.00
10 x 12	11.00	10·00	22.00	20.00
11 x 14	16.00	15.00	32.00	30.00
14 x 17	21.50	20.00	42.00	40.00

Immediate Delivery on Cleanable. One month on Washable.
Terms: C. O. D.

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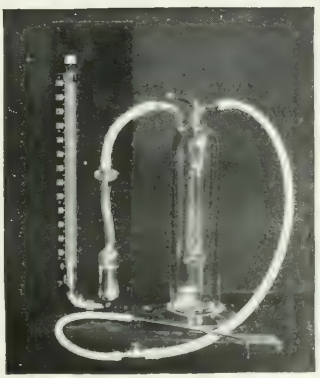
PNEUMOPERI-TONEUM APPARATUS

Price $20.00



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All types of Roentgen Ray Tubes Repaired

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The Establishment of
A Southern Branch
at
609 Common Street
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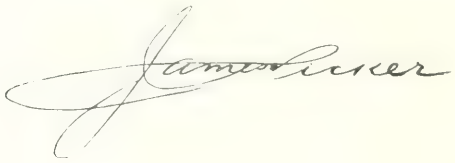
Loyal and responsive patronage of my customers has justified the opening of a Southern branch of Picker Service to facilitate even better service than that which seemed satisfactory.

I have equipped this branch with a complete supply of X-Ray accessories so that orders may be filled with the despach your needs require.

My associates in charge are men who have served Roentgenologists and know how to serve them with the efficiency that has always been attributed to Picker Service.



JAMES PICKER

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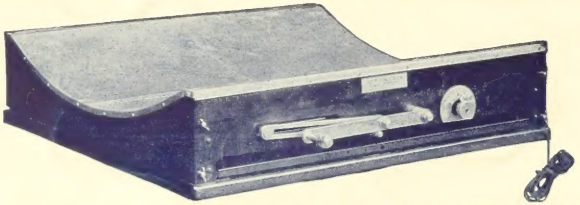
BRADY'S POTTER BUCKY DIAPHRAGM



For Finest Radiographic Work

We placed the first Bucky diaphragm on the market months ahead of other firms. Some of the first twelve are still in use by prominent roentgenologists. The many hundreds of satisfied users are our best "ads."

Now, after eighteen months, we have perfected a new grid that will give even finer detail than the original type. We are using the same type speed control as it has proven absolutely reliable and accurate.

We claim to have the smallest, neatest and most accurate Potter Bucky on the market. Electrically welded frame and base, with metal construction, make it practically indestructible. Takes all makes of cassettes up to 17x17. Operates in horizontal or vertical position. Exposure range from 1 to 90 seconds. Distance from 16 to 40 inches. Does stereoscopic work in either direction. Electric light signal device indicating when grid is moving, free if desired.

We absolutely guarantee radiographs free from the "Corduroy" lines, due to defective mechanism in some other makes.

YOU CANNOT GET A BETTER BUCKY AT ANY PRICE AND NO X-RAY LABORATORY IS COMPLETE WITHOUT ONE

Price $250.00 list, less 10% for cash within ten days, or $225.00 net.

X-RAY INTENSIFYING SCREENS

SWEETBRIAR SCREENS — Excellent quality throughout. They are guaranteed to be FREE FROM GRAIN, FAST, CLEANABLE, WITHOUT SACRIFICING SPEED, RELIABLE. Result—BRILLIANT RADIOGRAPHS. To introduce SWEETBRIARS we are offering a special discount of 20% from list price for cash in ten days.

PATTERSON SCREENS — There has been a change in price on Patterson Screens. We can now offer the single Pattersons in both REGULAR and CLEANABLE at one-half the Combination List. Discount 10% for cash in ten days.

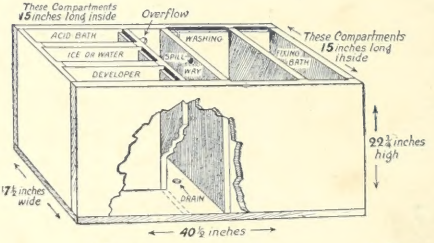
PARAGON SCREENS — A very fine product in every way. We do not hesitate recommending the PARAGONS for all ORDINARY RADIOGRAPHIC work. The price is especially low, being APPROXIMATELY ONE-HALF that of other standard makes. Cash discount from this low list, 5% for payment in ten days.

ALL SCREENS ARE SOLD SINGLY OR IN PAIRS, or we will mount them in YOUR OWN, or in NEW CASSETTES, if so desired. We will allow a discount of 20% from list on CASSETTES WHEN ORDERED WITH SCREENS.

STONE DEVELOPING TANKS

STOP COLD WEATHER TROUBLES

At this season a good tank is a valuable asset, as cold wash water may chill your developer so the plates develop very slowly and you do not get results. All our tanks have a space between the developer and wash compartments for hot water or ice to keep the developer at proper temperature. The 5-compartment style is a new one for general laboratory use. For hospitals or specialists we recommend the 6-compartment tank.



	4-Comp.	5-Comp.	6-Comp.
F. O. B. Chicago or Brooklyn	$45.00	$52.00	$58.50
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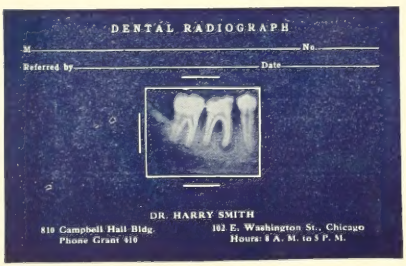
ENAMEL TANKS—3-compartment style, 8x10, $22.50—11x14 size, $27.00.

These prices subject to a 10% discount for cash in ten days.



DENTAL MOUNTS AND FILMS

We have many types of film mounts, including the green, gray and black cardboard with a celluloid window and all-celluloid mounts. We are offering same at lower prices and liberal discounts. Our new "SUNNYSIDE" MOUNT is guaranteed to remain flat. We also have a new cardboard mount without celluloid to hold the new Eastman Translucent Film with frosted back.

DUPLITIZED FILMS
BARIUM SULPHATE
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We handle a complete line of X-Ray supplies. We can promise quick shipments of reliable merchandise at low prices and liberal discounts. Get our quotation before you place your order elsewhere. Don't throw away good money. Before you invest—investigate.

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